THE IMMEDIATE EFFECT OF DRY NEEDLING OF THE MOST TENDER ACTIVE MYOFASCIAL TRIGGER POINT OF THE ROTATOR CUFF MUSCULATURE ON BOWLING SPEED IN ACTION CRICKET FAST BOWLERS.

By

DARREN SUBRAYAN

Dissertation submitted in compliance with the requirements for the Master's Degree in Technology: Chiropractic at the Durban Institute of Technology.

I, Darren Subrayan, do declare that this dissertation is representative of my own work in both conception and execution.

Darren Subrayan: [signature] Date: 22/08/2008

APPROVED FOR FINAL EXAMINATION BY: Supervisor:

Dr A.Docrat:
M.Tech: Chiro. [signature] Date: 22/8/2008

DEDICATION

I would like to dedicate this work to my family. To my parents who made so many sacrifices so that I could achieve my goals. Thank you for everything.

To my brother and sister thanks for all the support and help I could not have asked for better siblings. Thank you.

ACKNOWLEDGEMENTS

To my Supervisor Dr Docrat, thank you for all the guidance and support you have given to me not only as a lecturer but also as a friend. I have enjoyed all the laughs and jokes and I am proud to call you a friend.

To Dr Shaik, thank you for the help and guidance over the years. You have been a good friend. Thank you.

To my Off-campus clinician Bruce Grant, thank you for all your help and for finding time in your busy schedule to be my clinican. I really appreciate it.

To Jitesh, Nigel, Kanwal, Hitesh, Sanveer, Sarvesh, thanks for being such a great group of friends. I wish each of you success and happiness in your futures.

To Merissa, thank you for the support and the help I really appreciate it.

Abstract

Purpose

Cricket fast bowlers are prone to the development of Myofascial pain syndrome and in particular active myofascial trigger points in their rotator cuff muscles of the shoulder joint (Scott, *et al*. 2001). This is due to the severe stresses placed upon the muscles, bones and joints of the shoulder as a result of the high velocity throwing action (Bartlett, *et al*.1996).

In muscles containing active myofascial trigger points a decrease in the stretch range of motion as well as the maximal contractile force is noted, these two factors may negatively affect the speed at which a fast bowler deliver the ball (Travell, Simons and Simons, 1999).

Dry needling is viewed as the most effective means of deactivating myofascial trigger points leading to in increase in both the contractile force and range of motion of the affected muscle, which could increase the speed at which the bowler delivers the ball (Wilks, 2003). The aim of the study was to determine the immediate effect of dry needling active myofascial trigger points of the rotator cuff on bowling speed in action cricket fast bowlers.

Method

The study consisted of 40 participants (randomly split into two equal groups of 20) each with shoulder pain of a myofascial origin. Group A (intervention group) received the dry needling intervention in their most tender active myofascial trigger point. While participants in Group B (control group) received no treatment. Bowling speeds were measured both before and after the intervention, to determine its effect on bowling speed.

Data was entered into MS Exel spreadsheet and imported into SPSS version 15 (SPSS Inc.,Chicago, Iiiinois, USA), which was used for data analysis.

Paticipants were evaluated on bowling speed, Algometer readings and Numerical pain rating Scale (NRS) both pre and post intervention. Participants were also asked if they believed the intervention increased, decreased or had no effect on their bowling speeds.

Two sample t-test was used to compare baseline values between the groups. A repeated measure ANOVA was used to compare the rate of change of each outcome over time in the two groups. Pearson's correlation analysis (intra-group) was used to assess the strength and magnitude of correlations of the changes in the outcomes. The McNemar – Bowker test and Weighted Cohen's kappa statistics were calculated to assess agreement between perceived and actual levels of change.

Results

A significant treatment effect was observed in the intervention group were an increase in bowling speed, algometer readings as well a decrease in Numerical pain rating scale(NRS) scores was observed. There was also a perceived increase in the speed the participants delivered the ball in the intervention group. No significant changes were observed in the control group.

The findings of this study indicate that dry needling as a treatment modality would be beneficial to fast bowlers in not only increasing their speeds but also the pain experienced as a result of active myofascial trigger points.

TABLE OF CONTENTS:

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

DEFINITION OF TERMS

OVERHEAD ATHLETE

Athletes performing a wide variety of activities while the shoulder is placed in a position of elevation, abduction, and rotation. Examples of these superimposed activities include throwers and bowlers (Andrews, 1994).

ROTATOR CUFF MUSCLE GROUP

Four interrelated muscles (supraspinatus, infraspinatus, teres minor and subscapularis), originating from the scapula which provide the dynamic stability of the glenohumeral joint (lee, et al. 2000).

MYOFASCIAL PAIN SYNDROME (MPS)

Myofascial Pain Syndrome (MPS) is a regional muscular disorder that is characterized by the development of myofascial trigger points which may be either active and latent myofascial trigger points can result in MPS (Travell, et al.1999, Dommerhalt, et al.2006).

MYOFASCIAL TRIGGER POINT (MTrp)

A myofascial trigger point is defined as a focus of hyperirratibility and tenderness located in a palpable taut band of skeletal muscle (Dommerholt, *et al*. 2006). Myofascial trigger points become activated usually as a result of muscle overload which may be acute or sustained (Alvarez and Rockwell, 2003).

DRY NEEDLING

Dry needling is the insertion of an acupuncture needle directly into a trigger point. The needle is then withdrawn to the level of the subcutaneous tissue and then reinserted into the trigger point from different angles whilst maintaining the original source of entry into the skin (Dommerhalt, *et al*. 2006).

CHAPTER 1
INTRODUCTION

1.1 The problem and setting

Shoulder problems have become common among athletes involved in overhead throwing activities and in particular, cricket fast bowlers. These athletes are also susceptible to injury due to the high mechanical stresses placed upon the shoulder joint during the cricket bowling action (Wilk, *et al.* 1991).

The shoulder joint has the greatest range of motion of any joint in the body. This range of motion however leads to a lack of stability, which can make the shoulder vulnerable to injury (Lyman, *et al*. 2005). The shoulder joint plays a significant role in the overhead throwing action. It functions as a regulator of the throwing force which is generated primarily from the trunk and lower extremities (Burkhart, *et al*. 2003). Therefore a high velocity throwing action will be accompanied by large forces and torque which produce severe stress on the muscles, bones and joints of the upper extremity (Bartlett, *et al*. 1996).

The rotator cuff muscles function to stabilize the GH joint so that the larger shoulder movers (eg. latissimus dorsi) can carry out their function without significant motion of the humeral head on the glenoid (Scott, *et al*. 2002). A well balanced action of the rotator cuff muscles is necessary to obtain a stable centre of rotation during the overhead throwing action (Van der Hoeven and Kibler, 2006).

Due to the repetitive nature of the bowling action, cricket bowlers are prone to the development of myofascial trigger points in their rotator cuff muscles (Scott, *et al*. 2002). In a study conducted by Audie (2005) it was found that 62% of all overhead throwing athletes had trigger points within their shoulder musculature with 76.7% of the trigger points being located in the external rotators (ie. infraspinatus, posterior deltoid, teres minor).This shows that the stress placed upon the muscles during the overhead throwing action is a possible factor leading to the development of myofascial trigger points.

Myofascial pain syndrome is a regional muscular disorder that results from myofascial trigger points (Dommerholt, *et al*. 2006). The activation of myofascial trigger points usually is associated with some degree of mechanical abuse of the muscle in the form of muscle overload, which may be acute, sustained, or repetitive (Alvarez and Rockwell, 2002). An active myofascial trigger point is a focus of hyperirritability and tenderness located in a palpable taut band of skeletal muscle which refers pain at rest as well as during motion (Dommerholt, *et al*. 2006). In muscles containing active myofascial trigger points a decrease in the stretch range of motion as well as the maximal contractile force of the affected muscle is noted (Travel, Simons and Simons, 1999). These two factors could negatively affect cricket fast bowlers.

Treatment of myofascial pain syndrome is aimed at deactivating the active myofascial trigger point by the use of various therapeutic modalities. These modalities include myofascial trigger point injection, dry needling, massage, transcutaneos electrical nerve stimulation (TENS) and spray and stretch (Gerwin, *et al.* 2004). Of the all the modalities used in the treatment of myofasacial pain syndrome dry needling has been found to be the most effective form of treatment (Han and Harrison, 1997, Hong, 1994).

Dry needling is a modality used in the deactivation of active myofascial trigger points in which an acupuncture needle is inserted directly into a trigger point. The needle is then repeatedly inserted into the trigger point from different angles whilst maintaining the original source of entry into the skin (Dommerholt, *et al*. 2006).

Dry needling is viewed as the most effective means of deactivating an active myofascial trigger point (Han and Harrison, 1997). Deactivation of a trigger point means a decrease in the pain caused by the active trigger point as well as allowing the muscle to lengthen, restoring it to it original length from its shortened position, and also results in an increase in the maximal contractile force as well as an increase in the range of motion of the affected muscle (Wilks, *et al.* 2003).

In terms of the overhead throwing action, deactivation of myofascial trigger points contained in the shoulder musculature could result in an increase in the range of motion of the shoulder joint as well as in an increase in the maximal contractile force of the affected shoulder musculature (Wilks, *et al.* 2003). These factors could lead to an increase in the speed at which the bowler delivers the ball.

Another factor which could influence the subjects' bowling speed post intervention is the Hawthorne effect. In which the participants in the study may experience subjective changes as a result of the intervention. These participants may try to impress the researcher during the post-intervention, this is due to the fact that they were included in the study which may give them a feeling of importance that may increase their productivity. (Mouton and Marais, 1994).

1.2 Aims and Objectives

The aim of the study was to determine the immediate effect of dry needling of the most tender active myofascial trigger point of the rotator cuff muscles and its effect on bowling speeds of action cricket fast bowlers.

First Objective

To compare the bowling speed before the intervention (dry needling of the most tender myofascial trigger point of the rotator cuff muscles) to bowling speed after the intervention.

Second Objective

To determine the subjects' perception of change in bowling speed after the intervention compared to the actual change in bowling speeds post intervention.

Third Objective

To determine the correlation between Numerical Pain Rating Scale 101(NRS 101) and myofascial diagnostic scale to bowling speeds.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The following chapter provides a review of the available literature on the game of cricket. The chapter also analyses in detail the biomechanics and the various types of bowling actions and techniques that occur in cricket. The information reviewed will also provide an understanding of the current concepts of the etiology, treatment and nature of repetitive stress injuries and overuse syndromes experienced by overhead throwing athletes and in particular cricket bowlers. This chapter also gives a detailed review of the etiology, symptoms and some aspects of the treatment of Myofascial Pain Syndrome.

2.2 The Game of Cricket

Cricket is a game played between two competing teams of eleven players each, on a large expanse of ground called a pitch. In the centre of the pitch is a length of hardened flattened grass, called 'the wicket' (Marylebone Cricket Club, 1990). At each end of the wicket are placed three sticks adjacent to each other in an upright position, these are known as the 'stumps'. The stumps are separated by a gap not greater than the diameter of a cricket ball. On top of each set of stumps are placed two smaller sticks, or 'bails' (Lewis, 1992).

Cricket originated in England and is popular mainly in areas that formerly made up the British Empire, including England, Australia, India, Pakistan, Sri Lanka, Bangladesh, South Africa, New Zealand, Zimbabwe and the West Indies (Marylebone Cricket Club, 1990).

At any time in a cricket match there are two batsmen from one team (the batting team) on the pitch and 11 players from the opposing team (the fielding team) on the field.

Designated players from the fielding side, called bowlers, have the task of projecting a hard leather-covered ball towards the batsman. Each bowler has six consecutive attempts at bowling a cricket ball at the batsman. These six attempts constitute one over in the game (Lewis, 1992).

The bowler’s aim is to dismiss the batsman by:

- Bowling the ball in such a manner that the ball strikes the wickets, either directly or indirectly off the batsman.
- Bowling in a manner which forces the batsman to hit the ball into the air so that it can be caught by a fielder before it strikes the ground (Lewis, 1992).

The aim of the batsman is to score as many “Runs” as possible before he is dismissed. Runs can be scored in a number of ways: each time that the batting pair run between the wickets after a ball has been bowled, a run is scored. If the ball travels outside of the playing area, after having touched the ground prior to leaving the playing area, then four runs are scored. If the ball does not touch the ground on its way out of the playing area, six runs are scored (Marylebone Cricket Club, 1990).

When a batsman is dismissed, he is then replaced by the next batsman in the team’s line-up. Once ten batsmen are dismissed, it brings to an end the batting side’s innings. The total runs scored by all batsmen in the team constitute the score for that innings. The side which fielded first will then go in to bat for an innings. The team who has scored the most runs at the end of both innings wins the match (Marylebone Cricket Club, 1990).

The length of Cricket games can vary in duration of time, and the number of balls bowled. In a "Test" match each side has two innings to bat and bowl. At the end of both teams’ innings the side which has scored the most runs in both innings wins. Test matches are played over a period of five days (www.icc-cricket.com).

In "Limited Overs" Cricket, however, each side has only one innings and the duration of the match is fixed so as to complete the game in a day. The number of balls the batting side faces in its innings is limited usually to 50 overs. These matches are also called "One Day Matches" (www.icc-cricket.com).

2.2.1 Action or Indoor Cricket

This form of cricket is played in a large indoor arena between two teams of eight players each. This form of cricket is more popular among younger individuals between the ages of 16-26 (Thomas, 2007). The pitch in indoor cricket is same length as a conventional cricket pitch. The indoor playing area is completely enclosed by tight netting, which is approximately two meters from each side of the indoor pitch. This tight protective netting comprises the “walls” of the playing area. In action cricket each innings consists of 16 overs, with each player having to bowl two overs and bat in a partnership for four overs (www.indoorcricketworld.com).

Other differences from conventional cricket include:

1) Artificial grass matting is the playing surface.

2) The scoring and other rules may differ from conventional cricket.

3) A modified cricket ball with a softer centre is used (www.indoorcricketworld.com).

2.3 Cricket bowling

2.3.1 Bowling Speed

Cricket bowlers are usually classified as being slow, medium paced or fast bowlers. (www.icc-criket.com). Fast bowlers bowl at speeds of 130+ km/h while medium pace bowling speeds range between 110-130 km/h and slow bowlers bowl at speeds between 86-110 km/h (Lewis, 1992). These values may not apply to Action Cricket bowlers as there are differences in the run-up length, the playing surface and ball used (www.indoorcricketworld.com). Sood (2007) stated that a fast bowler in Action Cricket may bowl between 85-125 $km.h^{-1}$ or more according to Thomas, 2007.

2.3.2 Stages of the Bowling Action

Stage 1: Pre Delivery Stride

During the Pre Delivery stride the bowler begins running up to the pitch from a measured distance behind the non-striker's wicket, gradually increasing in speed. Each bowler sets his run-up distance by personal preference. It varies from 30 or more meters for fast bowlers to four or five steps for slow bowlers (Bartlett, *et al.* 1996).

Stage 2: Mid bound

Mid bound occurs in the last stride before the bowler reaches the pitch (Bartlett, *et al.* 1996). In this phase the bowler jumps off his left foot and then lands on the right or back foot (Marylebone Cricket Club, 1990). The bowler engages in this stride with the shoulders pointing down the wicket and with the right foot passing in front of the left foot and then turning to land parallel to the bowling crease (Bartlett, *et al*.1996).

Stage 3: Back Foot Contact

During this stage the bowler's dominant foot lands on the pitch, near the non-striker's bowling crease. At this point the bowler's body is rotated so that the dominant side is trailing, with the bowling arm held down behind the body, elbow straight, with the hand near the waist. His other arm is held high in front of the body, and acts as a counterbalance (Bartlett, *et al.* 1996).

Stage 4: Front Foot Contact

In this stage the bowler's leading or front foot lands on the popping crease. The bowler then brings his leading arm down while lifting his dominant arm up in an arc behind his body (Bartlett*, et al.*1996). When both of the bowlers' feet are planted on the pitch, the bowler then swivels his body around to bring his dominant shoulder forward, while his arm reaches the top of its arc above his head. His other arm also reaches the bottom of its counterbalancing swing. The bowler's upper torso flexes forward to provide additional momentum to the ball (Bartlett, *et al*. 1996).

Stage 5: Ball Release

During this phase the bowler releases the ball from his dominant hand near the top of its arc above the bowler's head (Bartlett, *et. al*.1996).

Stage 6: Follow Through

Here the bowler follows through with a few more steps down the pitch, veering off to the side to avoid running on the area of the pitch where the ball lands (Bartlett, *et al*. 1996).

2.3.4 Types of Bowling Action

Three basic bowling techniques have been identified by Bartlett, *et al.* (1996). These are the side-on, front-on and mixed techniques. It is almost impossible to isolate the boundaries between these techniques (Bartlett, *et al.* 1996).

The side-on technique is considered the most correct and effective bowling technique (Bartlett, *et al.* 1996). A bowler using this technique typically assumes a rear foot position that is parallel to the popping crease and at rear foot strike points his shoulders straight down the wicket, with a line passing through the bowlers shoulders being parallel to a line between the wickets (Bartlett, *et al*. 1996).

A fast bowler who adopts the front-on technique typically assumes a rear foot position that points straight down the wicket towards the direction the ball travels and has a more open-chested position with the line through the bowlers' shoulders creating an angle closer to 90 degrees with the line passing through the wickets (Bartlett, *et al.* 1996).

The mixed technique is a mixture of the two techniques described above. A bowler utilising this technique adopts a front-on foot and shoulder orientation at back foot strike and then realigns his shoulders to a more side-on position during his delivery stride (Bartlett, *et al.* 1996).

2.3.5 Types of Bowling

There are a number of different types of deliveries that medium and fast bowlers bowl in an attempt to get batsmen out (Lewis, 1992). A bouncer is bowled short so that it bounces steeply and is often aimed towards the batsman's head. Bowlers often try to bowl a Yorker which is a ball that pitches over a full length, almost landing under the batsman's bat which is difficult for the batsman to negotiate. The slower ball is another delivery often used by fast bowlers. This delivery is a disguised change in pace, in which the bowler bowls the ball slower than his normal speed. An inswinger is a delivery which swings into the batsman after bouncing, and an outswinger swings away from the batsman after bouncing. (Lewis, 1992).

Spin bowlers impart rotation to the ball before release by using either wrist or finger motions, the aim is for the ball to bounce and then deviate off the pitch before it reaches the batsman, thus making it difficult for the batsman to play the ball(Lewis,1992). Spin bowlers fall under the category of slow bowlers (Chappell, 1975).

2.4 Glenohumeral joint

2.4.1 Anatomy of the Glenohumeral joint

The glenohumeral (shoulder) joint is a multiaxial ball and socket joint and is the most freely mobile joint in the body (Freedman and Munro, 1966). This shoulder joint comprises the humerus, scapula and clavicle, which form three joints that are involved in the shoulder biomechanics and these include the sternoclavicular, acromioclavicular and the glenohumeral joint. These joints permit the multiaxial movements of the shoulder (Magee, 1997).The shoulder joint is a biomechanically unique joint due to the fact that at any given time only 25% to 30% of the humeral head articulates with the glenoid. This fact allows the shoulder to have a large and wide range of motion. This however comes at the expense of stability thereby creating a potentially unstable joint (Nicholas and Hershman, 1995). The humeral head is approximately one-third of a sphere; it is orientated at 45 degrees from the long axis of the shaft and retroverted 30 degrees. This large head of the humerus articulates with the shollow glenoid cavity of the scapula (Moore and Dalley, 2005). The shallow glenoid is deepened by a glenoid labrum, which is a fibrocartilaginous rim that attaches along the outer perimeter of the glenoid cavity. The fibrous capsule attaches to the margins of the glenoid cavity as well as the anatomic neck of the humerus (Moore and Dalley, 2005).

2.4.2 Biomechanics of the Glenohumeral Joint:

The glenohumeral joint is a ball and socket, synovial joint that depends on the muscles rather than bones or ligaments for its support and stability (Moore and Dalley, 2005). The joint has three degree axes and three degrees of freedom. In its resting position the glenohumeral joint is positioned at 55 degrees of abduction and 30 degrees of horizontal adduction and its closed packed position is in full abduction and lateral rotation (Magee, 1997). The biomechanics of normal shoulder movement are dependent on the static and dynamic stabilizers of the shoulder that provide stability through the full range of motion of the shoulder joint.

Glenohumeral (GH) joint stability is achieved by three important components which include:

- Joint geometry (Static Stabilizers),
- Ligamentous structures (Static Stabilizers),
- Neuromuscular structures (Dynamic Stability) (Nicholas and Hershman, 1995).

2.4.3 Static Stabilizers:

The shallow glenoid cavity is deepened by the fibrocartilaginous glenoid labrum as well as the intact ligamentus attachments at its perimeter (Moore and Dalley, 2005). This labrum provides stability to the glenohumeral joint and serves as an attachment site for the glenohumeral ligaments (Magee, 1997). When relaxed, the humerus sits in the upper part of the glenoid cavity with contraction of the rotator cuff muscles, the humeral head is pulled inferiorly into a wider part of the glenoid cavity. This inferior motion of the humeral head allows for full abduction of the glenohumeral joint to occur (Magee, 1997). The glenoid labrum functions to add stability to the glenohumeral joint, this is accomplished through deepening the socket. Loss of labral integrity may lead to instability of the shoulder joint and will eventually lead to degenerative changes (Meister, 2000).

There are two major mechanisms that contribute to labral injury. The first mechanism involves repetitive activities and throwing activities such as throwing, tennis serves, swimming and weight training. The second mechanism involves direct trauma to the labral region such as falling on a outstretched arm (Meister, 2000).The ligaments of the shoulder also contribute to static stability and these include: Glenohumeral ligaments (superior, middle, inferior with anterior, middle and posterior bands), Coracohumeral ligament, Coracoacromial ligament and Transverse humeral ligament (Moore and Dalley, 2005; Magee, 1997).

The static stabilizers of the shoulder are relatively unstable and must rely on the dynamic stabilzers (ie: shoulder musculature) to a large extent for stability (Alpert, *et al.* 2000).

2.4.4 Dynamic Stability

The rotator cuff muscles of the shoulder are generally responsible for dynamic stability of the glenohumeral joint (Lee, *et al.* 2000). The rotator cuff compriseso four muscles: the subscapularis, supraspinatus, infraspinatus and teres minor. Contraction of the rotator cuff muscles during activity contributes to stability by causing compression of the humeral head into the glenoid cavity and tightening of the capsular insertions of the rotator cuff (Alpert, *et al*. 2000).

This depressive function aids in preventing upward migration of the humeral head, which can lead to impingement on the overlying acromion and coracoacromial arch (Myers, *et a*l. 2007). Overhead throwing can cause sheer forces over the labrum and articular cartilage especially during forward acceleration. These sheer forces can result in injury and weakness to the static stabilzers of the shoulder joint. This weakness could place added strain on the dynamic stabilizers and could lead to subluxation (Myers, *et al*. 2007). Injury to the dynamic stabilizers can lead to difficulty in throwing and other overhead work activities as it would cause pain and dysfunction. Therefore, we can see that the shoulder joint relies heavily its dynamic stabilizers and that the rotator cuff plays a significant role in providing functional stability to the glenohumeral joint particularly during the overhead throwing motion (Alpert, *et al.* 2000).

2.5. The Biomechanics of Cricket Bowling :

The cricket bowling action can be compared to other overhead sports activities like a tennis serve, volleyball spike and baseball pitching due to the fact that all of these activities involve a similar pattern of arm motion with the same biomechanical principles applying (Glousman, 1993; Dillman, 1993).

2.5.1 The Baseball Pitching Action

According to Dillman *et al*. (1993), Escamilla *et al.* (2007) and Jobe *et al.* (1983), the pitching motion of a right-handed pitcher constitutes the following phases:

Wind Up:

This is the preparatory phase of the pitching motion. The right-handed pitcher's left knee is brought up towards his chest while the throwing and non-throwing hands are held together. The pitcher's non-throwing shoulder and hip face his target and the body weight is kept over the supporting (right) leg. During this phase the rotator cuff muscles are essentially inactive.

Early Cocking Phase:

During this phase the lower extremity moves forwards towards the ground, along with separation of the throwing and non-throwing hands. The throwing arm is placed in a semi-cocked position as the shoulder begins to assume an externally rotated position. Thereafter, the stride foot makes contact with the ground, thus signalling the end of this phase. In this phase the deltoid is responsible for initiating the abduction and external rotation of the shoulder joint. The Supraspinatus muscle counteracts the sheer forces generated by the deltoid and is the most active rotator cuff muscle during this phase.

Late Cocking Phase

This phase begins once stride foot contact occurs. In this phase rotation of the hips and trunk begins, with the shoulder achieving maximum external rotation in an abducted position allowing for impartation of maximal acceleration to the ball. During this stage the subscapularis muscle contracts and acts as a dynamic stabilizer anteriorly.

The Acceleration Phase:

During this phase, the shoulder rapidly moves from external to internal rotation. As the arm moves forward, the elbow extension begins and the forearm begins to pronate. This phase ends with the release of the ball. In this phase the rotator cuff muscles are minimally active with the pectoralis major and the latissimus dorsi muscle contracting concentrically.

The Follow Through (Deceleration Phase):

During this final phase the deltoid as well as the posterior rotator cuff musculature (Supraspinatus, Infraspinatus and Teres Minor) is the most active. This activity serves to decelerate the internal rotation of the upper extremity as the arm moves across the body. The throwing arm is adducted and extension of the stride knee occurs.

2.5.2 Shoulder Function During Bowling Action:

During the overhead throwing motion the shoulder joint functions as a regulator of the forces generated by the legs and trunk (Burkhart, *et al*. 2003). It is this regulating function as well as the high velocities accompanied by the throwing motion that place large forces and torque on the shoulder joint. These forces as well as the frequent repetition of the overhead throwing action produce severe stress on the muscles, bones and joints of the upper extremity (Bartlett, *et al.* 1996). Overhead throwing athletes have been found to have greater internal/external strength ratios in their dominant arm compared to their non dominant arm (Miester, *et al*. 2000). This finding shows that the overhead throwing action places large amounts of stress on the internal and external rotators of the shoulder.

To compensate for the severe stresses placed upon the joint, joint stability during the overhead throwing motion is maintained primarily by the action of the rotator cuff muscles of the shoulder (Lee*, et al.* 2000).

The function of the rotator cuff muscles is to stabilize the glenohumeral joint so that the larger shoulder movers (eg. deltoid muscle, pectoralis major muscle) can carry out their function without significant motion of the humeral head on the glenoid (Scott, et al. 2002). A well balanced action of the rotator cuff muscles is necessary to obtain a stable centre of rotation during the overhead throwing action (Van der Hoeven and Kibler, 2006).

The supraspinatus muscle lies across the top of the glenohumeral joint and provides joint compression. This joint compression counter-acts the sheer forces generated by the deltoid muscle on elevation of the arm (Glousman, 1993). Another function of supraspinatus is to assist the deltoid in abducting the arm (Lee, *et al*. 2000).The subscapularis muscle prevents anterior displacement of the humeral head as well as acting as an internal rotator of the arm. While the infraspinatus and teres minor both function as external rotators of the arm (Glousman, 1993).

2.5.3 Incidence of Shoulder Injuries in Throwing Atheletes:

The repetitive throwing motion places large forces on the athlete's shoulder and in particular the rotator cuff muscles (Wilk, *et al.* 1991). The rotator cuff plays an essential role in the overhead throwing motion. It functions with the static stabilizers of the shoulder to provide a balance of stability and mobility of the glenohumeral joint. The repetitve stresses placed upon the rotator cuff muscles during the overhead throwing action can lead to tendonitis, impingement and tearing of the rotator cuff muscles (Lee, *et al*. 2000).

The most common injuries occurring in sports are the overuse injuries, a muscular dysfunction in which a muscle can lose up to 50% of its normal strength. These injuries occur when muscles are subjected to either extreme or prolonged stress (Stretch, 1993;

Dennis, 2005). Cricket fast bowlers are more prone to overuse injuries as well as muscle and tendon injuries than all rounders or batsmen because of the repetitive nature of their bowling action as well as their high workloads (Dennis, 2005). In a study conducted by Adolfson and Lysholm (1991), 123 patients with painful shoulders were examined by arthroscopic examination to better understand the nature of rotator cuff lesions. It was found that 32% of patients had impingement syndrome, 16% had fibrosis and thickening, 6% had only inflammatory changes of the supraspinatus tendon. The remainder of the patients 55%, remained with an unclear diagnosis. Although myofascial Trp's were not investigated in the study, these findings suggest that Trp's may have been responsible for the shoulder pain in the majority (55%) of the patients. This view is shared by many authors who consider MTrp's among the most common causes of pain in the shoulder (Gerwin, et al. 2004).

The presence of MTrp's in overhead throwing atheletes was confirmed in a study conducted by Audie (2005) in which it was found that 62% of all overhead throwing athletes contained trigger points within their shoulder musculature with 76.7% of the MTrp's being located in the external rotators (ie. infraspinatus, posterior deltoid, teres minor).This shows that the stress placed upon the muscles during the overhead throwing action is a possible factor leading to the development of myofascial trigger points.

2.6 Introduction to Myofascial Pain Syndrome(MPS):

Myofascial Pain Syndrome (MPS) is an extremely common type of muscular condition that frequently presents to primary health care practitioners and is of a multi-factorial origin (Alvarez and Rockwell, 2002). Myofascial pain syndrome is a disorder characterized by the development of myofascial trigger points (Dommerholt, *et al*. 2006).

A myofascial trigger point is defined as a focus of hyperirratibility and tenderness located in a palpable taut band of skeletal muscle (Dommerholt, *et al*. 2006). Myofascial trigger points become activated usually as a result of muscle overload which may be acute or sustained (Alvarez and Rockwell, 2002).

Myofascial trigger points refer pain through specific patterns which may be distant from the location of the actual trigger point; this is termed "referred pain"(Travell, Simons and Simons. 1999; Alvarez and Rockwell, 2002). Trigger points may develop due to overuse, repetitive motions and excessive exercise (Alvarez and Rockwell, 2002).

In muscles containing trigger points there is a decrease in the stretch range of motion as well as the maximal contractile force of the muscle (Gerwin, *et al*. 2004). This weakness is a type of guarding mechanism in which the muscle is reflexively inhibited from full contraction due to pain (Travell, Simons and Simons. 1999).

2.6.1 Incidence of MPS:

Muscular pain is one of the most common work-related injuries as well as the second most common cause of visits to a primary health care practioner (Chatiow and Delany, 2002). Alvarez and Rockwel, (2003), suggest that approximately 23 million persons or 10 percent of the United States population have one or more chronic disorders of the musculoskeletal system.

Studies based at certain American pain clinics suggest that the incidence of MPS could be as high as 85% (Han and Harrison, 1997). Similar results were found by by Baldry *et al*. (2002), who found that trigger points were the primary cause of pain in 85% of 283 consecutive admissions to a pain centre program.

Travell, Simons and Simons (1999), suggest that individuals of any age or sex can develop trigger points, however it appears to be more prevalent among females. In a study conducted by Sola, *et al.* (1955) on 200 asymptomatic young adults it was found that latent myofascial trigger points were located within the shoulder musculature of 54% of the females and 45%of the males.

2.6.2 Etiology of MPS

MPS has been suggested to have multi-factoral etiologies (Travell, Simons and Simons, 1999). Acute injuries may cause immediate symptoms while chronic stresses are more likely to cause a gradual onset of symptoms. These chronic stresses are as result of repetitive movements or excessively long contractions (Alvarez and Rockwell, 2002).

Chaitow and Delany (2002) and Travell, Simons and Simons (1999), agree that several primary and secondary factors may lead to the activation or development of myofascial trigger points:

Primary etiological factors

- Nerve compression
- Adverse environmental conditions(excessive cold or heat)
- Maintaining the muscle in a shortened position for a prolonged period of time.
- Trauma
- Mechanical abuse(Acute sustained or repetitive overlaod)
- Systemic biomechanical imbalances

Secondary etiological factors

- Low oxygenation of tissues
- Satellite trigger points (arise in the referral zone of other trigger points)
- Compensating synergistic or antagonistic muscles of muscles already containing trigger points may also develop trigger points.

The events which lead to the development of myofascial trigger points are usually different from the factors which perpetuate them (Alvarez and Rockwell, 2002,).Therefore the long term prognosis improves with treatment of these perpetuating factors. Esenyl *et al.* (2000) found that once perpetuating factors were corrected the pain and dysfunction experienced by the trigger points was more likely to be resolved.

Perpetuating factors of trigger points are:

- Metobolic and Endocrine inadequacies. (eg.Hypermetabolism)
- Mechanical stress. (eg. Muscle constriction)
- Nutritional inadequacies. (eg.thaimine)
- Psychological factors. (eg.depression)
- Chronic infection and infestation. (eg. viral infection)
- Miscellaneous factors. (eg. allergy, fatigue) (Travell, Simons and Simons, 1999)

2.6.3 Symptoms of Myofascial trigger points:

The pain resulting from myofascial trigger points varies from a mild ache to excruciating pain that is either sharp, dull, burning or heavy and is usually associated with general fatigue, decreased range of motion and muscle strength (Han and Harrison, 1997). Patients usually seek treatment for the spontaneous referred pain that occurs when a trigger point becomes active. Trigger points can also affect the autonomic nervous system producing numerous signs such as: coryza, lacrimation, sweating and proprioceptive disturbances eg. Dizziness (Alvarez and Rockwell, 2002).

Pain referred from trigger points usually follows a characteristic referral pain pattern for each muscle.

2.6.4 Presentation of Myofascial Trigger Points of the Rotator Cuff muscle Group:

Supraspinatus – Active trigger points cause a deep ache of the shoulder mainly in the mid deltoid area. The ache may also extend down the arm and forearm focusing strongly over the lateral epicondyle of the elbow. Pain is felt strongly during abduction of the arm and patients may report difficulty combing their hair or brushing their teeth. Patients may also report restricted shoulder range of motion during overhead sports activities, such as a tennis serve (Travell, Simons and Simons, 1999).

Infraspinatus - The referred pain as a result of active Trigger points causes a deep intense pain in front of the shoulder, especially when sleeping on their side. Patient complain of difficulty reaching behind to a back pocket. There is also a restriction of internal and external glenohumeral joint rotation (Travell, Simons and Simons, 1999).

Teres Minor - Patients with active trigger points experience posterior shoulder pain that may include dysthesia of the 4^{th} and 5^{th} digits. There is a slight restriction of internal rotation of the glenohumeral joint on the Hand- to-Shoulder blade test (Travell, Simons and Simons,1999).

Subscapularis -Referred pain concentrates in the posterior deltoid area and may extend medially over the scapula, down the posterior aspect of the arm then skip to a band around the wrist. Patient examination reveals a restriction of either abduction or external rotation of the arm at the glenohumeral joint (Travell, Simons and Simons, 1999).

2.6.5 Signs of Myofascial trigger points:

On palpation trigger points are described as being taut bands of muscle fibers that are ropy and tender to the touch and when palpated create a local twitch response (Gerwin, *et al*. 2004).

Trigger points may be active or latent.

Active Myofascial Trigger Point:

An active myofascial trigger point is a focus of hyperirritabiity in a muscle or its fascia that is symptomatic with respect to pain; it refers to a pattern of pain at rest, in motion or on compression that is specific for that muscle. It is always tender on direct compression, prevents full lengthening of the muscle and weakens the muscle (Travell, Simons and Simons, 1999; Alvarez and Rockwell, 2002).

Latent Myofascial Trigger Point:

Is defined as a focus of hyperirritability in a muscle or its fascia that is clinically silent with respect to spontaneous pain, it is only painful when palpated. A latent myofascial trigger point may have all the other characteristics of an active trigger point (Travell, Simons and Simons, 1999; Alvarez and Rockwell, 2002).

Travell, *et al.* (1999), has put forward the following signs which are evident upon examination of myofascial trigger points:

- Pain within the affected muscle is increased by passive stretching of the muscle.
- Sustained, moderate pressure on a myofascial trigger point produces or increases pain in the referred pain zone of the trigger point.
- The range of motion, of affected muscle, is decreased.
- Contracting the muscle against resistance significantly increases the pain.
- Tenderness and dysthesias are commonly referred in characteristic, well-defined zones.
- Firm pressure applied over the point usually elicts a "jump sign", with the patient crying out, wincing or withdrawing from the stimulus.
- One or several fasciculatons, called local twitch response, may be observed when firm pressure is applied over the point.

2.6.6 Diagnosis of myofascial trigger points:

According to Alvarez and Rockwell, (2003), the most reliable diagnostic criteria of trigger points on examination is the presence of exquisite tenderness of a papable taut band in skeletal muscle. The patient may also complain of decreased range of motion and muscle strength (Dommerholt, *et al*. 2006)

The signs of a trigger point are as follows:

- Referred pain in the zone of reference
- Local twitch response
- Palpable taut band
- Focal tenderness (Gerwin, *et al*. 2004)

The essential criteria for the indentification of myofascial trigger points according to Travell, Simons and Simons (1999) are:

- Taut palpable band
- Exuisite spot tenderness of a nodule in a taut band
- Patient recognition of current pain as a result of pressure being applied to a tender nodule
- Painful limitation of stretch range of motion

For the diagnosis of a myofascial trigger points all four essential criteria must be present (Travell, Simons and Simons, 1999).

Motor disturbances that occur as a result of myofascial trigger points include:

- Muscle weakness
- Spasm of synergistic and/or antagonistic muscles.
- Decreased muscle power or work tolerance (Travell, Simons and Simons, 1999, Gerwin, *et al*. 2004,)

2.6.7 Effects of Myofascial Trp's:

Muscle weakness:

In muscles containing myofascial trigger points, weakness is a form of reflex motor inhibition and occurs without atrophy of the affected muscle (Alarez and Rockwell, 2003). This weakness is a type of guarding mechanism, in which the muscle is, reflexly inhibited from full contraction as a result of pain (Gerwin, *et al.* 2004). Weakness in a muscle also occurs as a result of a change in the resting length of the affected muscle. Muscles containing trigger points are already shortened at the time of contraction (Travell, Simons and Simons, 1999). Therefore, if the muscle is already shortened it will be weakened and the force of contraction of the muscle will be less than normal (Wheeler, 2004). When the trigger point is inactivated and the taut band is released (ie. by dry needling), the pain experienced will decrease, the range of motion will be restored and therefore the affected muscles' contraction strength will return to normal (Wheeler, 2004).

Another possible cause of weakness is as a result of arthrogenic muscle inhabition (AMI), which is a natural response designed to protect the affected joint or structure from further damage (Hopkins and Ingersoll, 2000). AMI is the body's most common mechanism of protecting extremities (Ingersoll, *et al*. 2003).In muscles containing trigger points AMI results in altered muscle activity surrounding the joint (Lucas, *et al*. 2004). The patient will therefore replace normal muscle patterning with an adopted abnormal motor program (Ingersol, *et al*. 2003).

Decreased range of motion:

A muscle containing a trigger point is prevented by pain from reaching its full stretch range of motion(Travell, Simons and Simons, 1999). If one attempts to passively stretch the muscle beyond its limit, an increase in pain will result. This is due to the fact that the muscles involved are already under increased tension at their rest length (Travell, Simons and Simons, 1999).

In a case study conducted by Grieve (2005), in a patient whose left ankle previously showed a complete limitation in dorsiflexion (0°),it was observed that deactivation of active myofascial trigger points contained within the gastrocnemius muscle resulted in a 10-15º increase in range of motion of left ankle dorsiflexion. These findings were also confirmed in a study by Hseih *et al*. (2007), who found that dry needling of a the most tender myofascial trigger point of the shoulder musculature resulted in an increase in both active and passive range of motion of internal rotation of the shoulder. It was also observed that the pain intensity of the shoulder which was treated reduced significantly after the dry needling intervention.

These studies suggest the presence of myofascial trigger points results in a decrease in the range of motion of the joint and that deactivation of these myofascial trigger points results in an increase in range of motion.

Altered biomechanics:

Muscles which contain trigger points fatigue at a faster rate and become exhausted before muscles without trigger points. These muscles also recover at a slower rate when compared to muscles that do not have trigger points (Travell, Simons and Simons, 1999; Dommerhalt, *et al*. 2006). Trigger points in a specific muscle can also cause weakness or inhibition in adjacent muscles. This inhibition can lead to a major disruption of normal functioning and therefore biomechanics (Travell, Simons and Simons, 1999; Dommerhalt, *et al*. 2006).

Lucas *et al.* (2004), found that trigger points within the scapular rotator muscles resulted in changes in the muscle activation pattern of scapular rotator muscles as well as muscles further distal in the kinematic chain. Deactivation of these trigger points normalized muscle activation of the kinematic chain. This suggests that trigger points in a proximal body segment like the shoulder can affect shoulder biomechanics by leading to distal segments altering their workloads in order to preserve the movement outcomes of the kinematic chain. These altered workloads place greater strain on the distal segments predisposing them to injury (Lucas, *et al*. 2004).

2.6.8 Management of MPS

According to Alvarez and Rockwell (2003), a large part of patient management is recognizing the underlying factors which influence the patient's pain by increasing the tension and irritability of the involved muscle. Therefore when treating MPS, the treatment protocol must take into account both the contributing and perpetuating factors, so as to provide long term relief (Esenyl, *et al*. 2000).

There are many forms of treatment for MPS. These include: myofascial trigger point injection, dry needling, massage, transcutaneos electrical nerve stimulation (TENS) and spray and stretch (Gerwin, *et al.* 2004).For the purposes of this study, only the dry needling and injection treatment protocols will be discussed.

2.6.9 Injection and Dry needling of Trigger Points

Dry needling is the insertion of an acupuncture needle directly into a trigger point. The needle is then withdrawn to the level of the subcutaneous tissue and then reinserted into the trigger point from different angles whilst maintaining the original source of entry into the skin (Dommerhalt, *et al*. 2006).

According to Shah *et al.* (2006), dry needling is viewed as an effective form of treatment for myofascial trigger points. This is confirmed by Travell *et al.* (1999), who concluded that dry needling and acupressure were more effective than transcutaneous injection of either local anesthetic or local anesthetic and steroids.

In a study conducted by Han and Harrison (1997) dry needling without injection of any medication resulted in an improvement of 63%. The results of their study indicated that dry needling appear to be the most effective treatment for myofascial trigger points.

Dry needling results in the immediate deactivation of trigger points. This was demonstrated in a study conducted by Hong (1994) in which dry needling was used to deactivate myofascial trigger points and showed that 58 percent of patients reported complete relief of pain immediately after trigger point injection and the remaining 42 percent of patients claimed that their pain was minimal (one or two on the NRS pain scale).

According to Hong (1994), the critical therapeutic factor leading to deactivation of trigger points as well as relief of pain is the mechanical disruption by the acupuncture needle of nerve endings or contractile elements of the muscle. Therefore it appears that the therapeutic effect gained is as a result of the needle rather than any substance injected into the trigger point (Dommerhalt, *et al*. 2006).

Dry needling leads to the deactivation of myofascial trigger points, which leads to an increase in the stretch range of motion as well as of the maximal contractile force of the affected muscle (Wilks, 2003).

Han and Harrison (1997), propose the following mechanism by which dry needling leads to the deactivation of Trp's:

- Mechanical disruption of muscle fibers,leading to a release of potassium, which results in depolarization of the nerve fibers.
- Mechanical disruption of nerve fibers.
- Interruption of central feedback mechanism that perpetuates pain.
- Vasodilatory effect of local anesthetics which increases the removal of metabolites.
- Local dilution of nociceptive substances by the local anesthetic or saline that is infiltrated.

3. The Hawthorne effect

The Hawthorne effect describes a temporary change to behavior or performance in response to a change in the environmental conditions, with this change typically being an improvement (Mouton and Marais, 1994). The Hawthorne Effect was first reported following an extensive research programme investigating methods of increasing productivity in the Western Electrical Company's Hawthorne Works in Chicago during the 1920s(McCarney et al. 2007). The finding of the study was that no matter what change was introduced to working conditions, the result was increased productivity. For example, improving or reducing the lighting in the production areas under test produced similar effects.

The Hawthorne effect has been defined as 'an increase in worker productivity produced by the psychological stimulus of being singled out and made to feel important (McCarney et al. 2007). Subsequently the definition has been broadened; here it refers to treatment response rather than productivity (Mouton and Marais, 1994).

Although first reported in industrial research, the Hawthorne Effect has implications for clinical research (Mouton and Marais, 1994). In terms of this clinical study, participants may experience subjective changes as a result of the dry needling intervention. These participants may try to impress the researcher during the post-intervention bowling speed measurement. This is due to the fact that they were included in the study which may give them a feeling of importance that may increase their productivity. (Mouton and Marais, 1994).

4. Conclusion

The literature that has been presented has shown a prevelance of myofascial trigger points within the shoulder musculature of overhead throwing atheletes (Audie, 2005). These myofascial trigger points lead to a decrease in the range of motion and strength of the shoulder joint (Travell, Simons and Simons, 1999). These factors are believed to have a negative effect upon the speed at which a bowler delivers the ball. Dry needling has been shown as the most effective form of treatment for active myofascial trigger points, leading to the immediate deactivation of an active myofascial trigger point (Han and Harrison, 1997, Hong, 1994). This deactivation of the myofascial trigger points restores the normal range of motion and also the maximal contractile force of the affected muscle. This increase in range of motion has been confirmed by a study conducted by Hseih *et al*. (2007) which found that dry needling leads to an increase in both the active and passive range of motion of the shoulder. These factors could lead to an increase in the speed at which the bowler delivers the ball.

CHAPTER 3

MATERIAL AND METHODS

3.1) Introduction

This chapter is an outline of the procedures followed in the execution of this research study. It includes a detailed description of the study design and protocol, methods used in gathering of subjective and objective data as well as the methods of statistical analysis used for evaluation of the data.

3.2) Study Design

This was a randomised controlled investigative trial.

3.3) Advertising

Advertisements (Appendix G) were placed at local Action Cricket arenas. To maximise the exposure of the study advertisements were also placed at various First level cricket clubs around Durban, and at the Sahara Kingsmead Cricket Stadium. Participants were also recruited personally by the researcher. Prospective participants were requested to contact the researcher telephonically for information pertaining to the study. There were no restrictions in terms of ethnicity, sex, religious beliefs or socioeconomic standing.

3.4) Sample Size

A non-probability, convenience sampling technique as well as purposive sampling technique were used. A sample size of 40 healthy Action Cricket fast bowlers was obtained. Those responding to the advertisements were given more information regarding the nature of the research by the researcher (personally or telephonically) and invited to a consultation at the relevant Action Cricket arena.

3.5) Method

3.5.1) Consultation

Each consultation was supervised by a qualified clinician (i.e. registered chiropractor). At the consultation each participant was given the letter of information (detailing the procedure of the study) to read (Appendix D) and an informed consent form (Appendix H) to sign. The entire research protocol was explained in detail to every prospective participant by the researcher. Each prospective participant then underwent a medical case history (Appendix I), physical examination (Appendix J), and shoulder orthopaedic examination (Appendix K). After the participant met the inclusion criteria for the study they were then given the opportunity to join the study.

3.5.2) Inclusion Criteria:

- All participants were cricket bowlers with myofascial pain.
- All participants had at least one active myofascial trigger point within any of their rotator cuff muscles. Participants presented with the following: Jump sign, Referred pain at rest, Local twitch response, Palpable taut band in the muscle and focal tenderness (Travell, *et al*. 1999).
- All participants were between the ages of 18 to 40 years. Due to the fact that cricket injuries occur most frequently between the ages of 18 to 40 (Finch, *et al*. 1999).
- All participants read and signed the informed consent form.
- All participants did not have any previous shoulder surgery.

3.5.3) Exclusion Criteria

- Any participants with contra-indications to dry needling. These include: Systemic illness (eg. malaria, Elhers Danlos syndrome), bleeding and anticoagulant disorders, fever, anxiety etc. patients who are afraid of needles were excluded (Travell, *et al*. 1999).

- No spin bowlers were included in the study.

- Patients on analgesic or anti-inflammatory medication and who want to participate in the study required a wash out period of forty eight hours in which the participant did not use any of the above medication for forty eight hours prior to joining the study.

Patients were excluded from the study:

- If there was a history of traumatic shoulder dislocation

- If there is a positive drop arm test which could indicate a rupture of the rotator cuff.

- If the participant on physical examination had any pain referring to the shoulder suggesting a cardiac, pulmonary or systemic disease.

3.5.4) Group Allocation

Participants were allocated into two groups by using stratified statistical sampling. Group A received dry needling of their most painful active myofascial trigger point of the rotator cuff muscles while those in Group B received no treatment (control). Participants in the control group (Group B) with their most tender active myofascial trigger point in a particular muscle were matched to a participant in group A (The group receiving the dry needling intervention) with their most tender active trigger point being located in the same muscle. Participants were matched by a combination of the location of their most tender active trigger point, their algometer reading as well as their NRS pain rating. For one participant to be matched to another they required their most tender trigger point to be located within the same muscle of the rotator cuff musculature as well as less than a one kilogram difference on their algometer readings and a difference of 30 or less on the NRS pain rating scale. In this way the effect of the intervention was more accurately compared.

3.5.5) Bowling speed

The participants were then asked to perform a set five minute stretch procedure (Appendix D) which was explained and demonstrated to the patient by the researcher. This stretching procedure served as a warm up as well as to prevent injury to the participant. The participants were then asked to bowl in the action cricket nets as fast as possible. The participants were required to bowl twice and the bowling speeds were measured using the 'Speedcheck' sports radar. An average of the two measurements was recorded. This constitutes one set of measurements.

3.5.6) Dry Needling Intervention

The researcher then palpated the rotator cuff muscles to identify the most tender active myofascial trigger point which was confirmed by using the Numerical Pain Rating Scale, Myofascial Diagnostic Scale as well as a pressure algometer, which is a proven way of quantifying tenderness of soft tissue (Bernhadt, *et al*. 2007). If the patient was allocated to Group A the researcher then dry needled this active trigger point. After the dry needling intervention a henna stain was used to mark the area that was needled.

3.5.7) Dry Needling Procedure

Once a trigger point had been located and the overlying skin had been cleansed with alcohol, the researcher isolated the trigger point with a pinch between the thumb and index finger or between the index and middle finger. Adhering to all needling precautions, a sterile acupuncture needle was then inserted 1 to2 cm away from the trigger point so that the needle may be advanced into the trigger point at an acute angle of 30 degrees to the skin. The stabilizing fingers applied pressure on either side of the injection site, ensuring adequate tension of the muscle fibers to allow penetration of the trigger point but preventing it from rolling away from the advancing needle. The needle was then withdrawn to the level of the subcutaneous tissue and then reinserted into the trigger point from different angles (Fisher, 1996). This withdrawal and reinsertion known as fanning, occurred ten times to each participant in the study who received the dry needling intervention.

3.5.8) Dry Needling precautions:

- All acupuncture needles were used once only.
- The needles were opened in full view of the patient.
- The areas needled were sterilised with an alcohol swab and a sterile piece of cotton wool was used with the removal of the needle from the skin.
- The used needle was then discarded into the waste needle bin.
- The researcher was wearing surgical gloves at all times during the treatment.

3.5.9) Post intervention bowling speeds

Within five minutes of the dry needling intervention the patient was asked to bowl again in the action cricket nets as fast as possible. Participants were again required to bowl twice and their bowling speeds were measured using the ‘Speedcheck’ sports radar. An average of the two measurements was again recorded. This constituted the second set of measurements. These measurements were compared with the first set of measurements prior to the dry needling intervention to determine the effect of the intervention.

The researcher then repalpated the most painful active trigger point which was needled and also marked using a henna stain. This trigger point was then reassessed using a pressure algometer, NRS pain rating scale as well as the myofascial diagnostic scale to determine if there was any change in the pain experienced by the participant after the dry needling intervention.

3.6) Outcome measures

3.6.1) Bowling speed

The participants were asked to bowl in the action cricket nets as fast as possible. The participants were required to bowl twice and the bowling speeds were measured using the 'Speedcheck' sports radar. The average of the two measurements was recorded. This constituted the second set of measurements. The first set of recordings was taken before the intervention and the second set was recorded immediately after the dry needling intervention.

3.6.2) Perception of Speed

Participants in both groups were required to answer the following question posed by researcher: "Did you feel that your bowling speed increased, decreased, or did not change after the intervention?" The researcher then recorded the responses as indicated in Table 1 (Appendix H). This question determined if the participants generally thought their bowling speeds increased, decreased, or didn't really change after the particular intervention, and was compared to the objective measurements of bowling speed. This was used to determine the role of the Hawthorne effect (Mouton and Marais, 1994).

3.6.3) Patient perception Table

Increased	Decreased	No change

3.6.4) Summary of Procedure

Stretch and warm up exercises for eight minutes (Appendix D)	
Bowling speed measured	
Trigger point examination of rotator cuff muscles(using pressure algometer, NRS scale and myofascial diagnostic scale)	
Group A	Group B
Participants receive Dry needling of the most painful active trigger point in the rotator cuff musculature.	Participants in this group receive no treatment.
Immediately after the dry needling intervention bowling speed was measured for a second time and compared to the first set of measurements	
The trigger point that was needled and marked with a henna stain was repalpated using an algometer to observe any change in tenderness (using pressure algometer, NRS scale and myofascial diagnostic scale).	

3.6.5) The need for the control group (Group B):

Participants who receive the dry needling treatment may try to impress the researcher during the post-intervention bowling speed measurement (Hawthorne effect: Mouton and Marais, 1994). In order to minimise this effect, it was necessary for a control group (who receive no intervention) to be included in this study. Each participant in the control group was matched to a participant receiving the dry needling intervention. Participants were matched by a combination of the location of their most tender active trigger point, their algometer reading as well as their NRS pain rating. For one participant to be matched to another they required their most tender trigger point to be located within the same muscle of the rotator cuff musculature as well as less than a one kilogram difference on their algometer readings and a difference of 3 or less on the NRS pain rating scale. In this way the effect of the dry needling intervention was more accurately compared. The matching of participants had the same effect as randomization of participants into the two groups. Thus the treatment and control groups were treated as independent from a statistical perspective and tests for two independent groups were applied.

3.7) Measurement Tools

3.7.1) Algometer

The pressure algometer is a tool used to determine the pressure pain threshold of specific muscle and bone locations. The Algometer also works for evaluating the degree of trigger point tenderness (Jtech Medical, 2002).

3.7.2) "Speedcheck" Sports Radar:

This device utilizes Doppler signal processing to measure speeds. When activated, an internal antenna sends out radio waves at a specific frequency. When a moving object such as a thrown ball enters this transmitted signal, then the frequency of this reflected signal off the ball is changed, and this change in frequency is proportional to the ball's speed. The radar then displays the speed in the units of choice, either kilometers per hour or miles per hour. The signal transmitted is able to pass through materials such as Plexiglass, netting, white mesh fencing, backdrops, or tarps without being affected. Therefore a protective barrier can be placed between the moving object and the radar without affecting the accuracy of the measurements in any way (SpeedTrac sports radar setup, 2006). The "Speedcheck" Sports Radar will be set up according to Appendix L.

3.7.3) Statistical analysis

SPSS version 15.0 (SPSS Inc., Chicago, Illinois, USA) was used to analyse the data. An A p value <0.05 was considered as statistically significant. The participants in each group were matched on criteria such as baseline Numerical Rating Scale, Algomater scores as well as the location of the participants' most tender trigger myofascial trigger points. This had the same effect as randomization of participants into the two groups. Thus the treatment and control groups were treated as independent from a statistical perspective and tests for two independent groups were applied. A student's two sample t-test was used to compare baseline values between the groups. A repeated measure ANOVA was used to compare the rate of change of each outcome over time in the two groups. A significant time by group interaction effect denoted a significant treatment effect. Time by group profile plots were generated in order to examine the direction and magnitude of the treatment effect in order to make a conclusion as to the effectiveness of the treatment. Pearson's chi square test was used to compare the patient perception of change in bowling speed between the groups. The McNemar – Bowker test and Weighted Cohen's kappa statistics were calculated to assess agreement between perceived and actual levels of change. Pearson's correlation analysis (intra-group) was used to assess the strength and magnitude of correlations of the changes in the outcomes.

Chapter 4

The Results

4.1) Introduction

This chapter presents results obtained from the study. The demographics of the participants are presented, followed by statistical analysis of the study data.

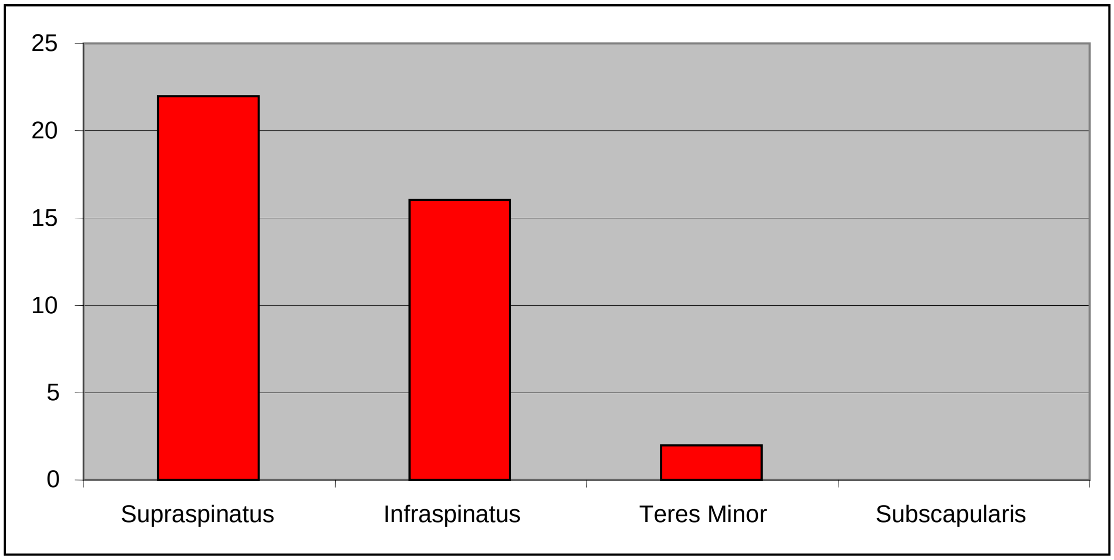
4.2) Demographics

Forty male action cricket bowlers participated in the study. The participant's ages ranged from 18 to 36 years. The mass of participants ranged from 58 to 92 kgs, while the Body Mass Index (BMI) ranged from 17.5 to 30.5 $kg.m^{-2}$.

Variable	**Mean ± SD**
Age (years)	25.93 yrs ± 5.50
Mass (kg)	72.46 kgs ± 9.30
Height (m)	1.73 m ± 6.50
Body Mass Index (BMI) ($kg.m^{-2}$)	24.3 $kg.m^{-2}$ ± 3.30

The majority (n=38) of the participants in the study were right shoulder dominant with only two participants being left shoulder dominant. The location of the most tender active myofascial trigger point of the rotator cuff musculature in participants in the study had a higher incidence within the Supraspinatus muscle (n=22) followed by the Infraspinatus muscle (n=16), with only two participants containing their most active trigger points within the Teres minor muscle. None of the participants in the study presented with their most tender active myofascial trigger point within the Subscapularis muscle.

Figure 1: location of most tender active myofascial trigger point of the rotator cuff muscles



4.3) Results

4.3.1) Comparison of baseline values

Table 1: Comparison of mean NRS, algometer and bowling speed between the two groups pre intervention

	group	N	Mean	Std. Deviation	Std. Error Mean	p value
NRS pre	A	20	6.70	1.218	0.272	0.596
	B	20	6.50	1.147	0.256	
algometer pre	A	20	3.740	0.4661	0.1042	0.720
	B	20	3.795	0.4957	0.1109	
bowling speed pre	A	20	105.60	11.763	2.630	0.711
	B	20	106.75	7.203	1.611	

It was important to ensure that baseline values were not significantly different in the two groups, since differences found after the treatment could possibly be attributed to these baseline differences. The mean Numerical Pain Rating Scale (NRS), algometer and bowling speed of the two groups prior to the intervention were tested. There were no significant differences between the groups for any of these outcomes. Thus the two groups were comparable. This is shown in Table 1.

<u>4.4) To evaluate of the treatment effect</u>

4.4.1) Numerical Pain Rating Scale

<u>Table 2: Repeated measures ANOVA analysis for the effect of the intervention on NRS</u>

In the table below the p value was 0.037 (p<0.05 is statistically significant), which indicates that the effect of the intervention on the Numerical Pain Rating Scale was statistically significant.

Effect	**Statistic**	**p value**
Time	Wilk’s lambda = 0.366	<0.001
Time*group	Wilk’s lambda =0.891	0.037
Group	F=0.869	0.357

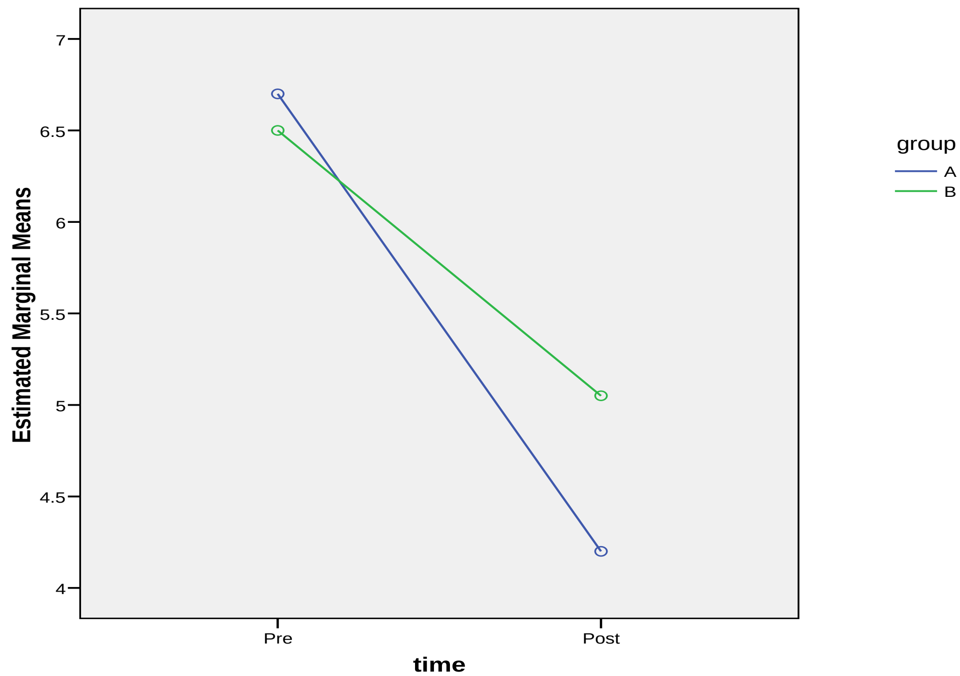


Figure 2: Mean NRS by time and group

Table 2 shows that there was a statistically significant time effect for Numerical Pain Rating Scale (NRS), thus in both groups combined Numerical Pain Rating Scale (NRS) values decreased significantly over time. However, the time by group interaction effect was also statistically significant (p=0.037) thus indicating that there was a statistically significant treatment effect. Figure 2 shows that the profiles over time of the two groups were not parallel, and that the slope of Group A (intervention group) was steeper over time than that of Group B (Control group). The two lines crossed over, indicating that the effects on the Numerical Pain Rating Scale (NRS) over time in the two groups were not equal. The effect in the treated group was greater than that in the control group.

4.4.2) Algometer

Table 3: Repeated measures ANOVA analysis for the effect of the intervention on Algometer

Effect	Statistic	p value
Time	Wilk's lambda = 0.556	<0.001
Time*group	Wilk's lambda =0.873	0.024
Group	F=0.261	0.613

In the table above the p=0.024 which indicates that the effect of the intervention on the algometer reading was statistically significant.

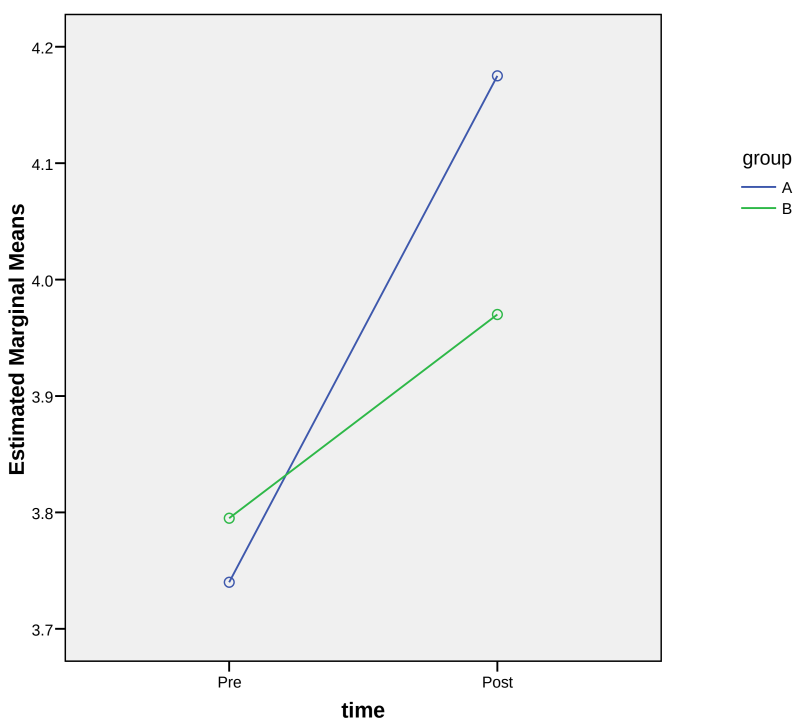


Figure 3: Mean Algometer by time and group

Table 3 shows that there was a statistically significant time effect for algometer, with both groups' combined Numerical Pain Rating Scale (NRS) values increasing significantly over time. However, in the intervention group the time by group interaction effect was statistically significant (p=0.024) thus indicating that there was a statistically significant treatment effect. Figure 3 shows that the profiles over time of the two groups were not parallel, and that the slope of Group A (intervention group) was steeper over time than that of Group B (Control group). The two lines crossed over, indicating that the effects on algometer over time in the two groups were not equal. The effect in the treated group was greater than that in the control group. Although the two groups started at around the same level pre treatment, after treatment the treated group had a much higher mean algometer level than the control group.

4.4.3) Bowling speed

Table 4: Repeated measures ANOVA analysis for the effect of the intervention on bowling speed

Effect	Statistic	p value
Time	Wilk's lambda = 0.727	0.001
Time*group	Wilk's lambda =0.848	0.013
Group	F=0.011	0.918

In the table above p=0.013 indicating that the intervention had a statistically significant effect on bowling speed.

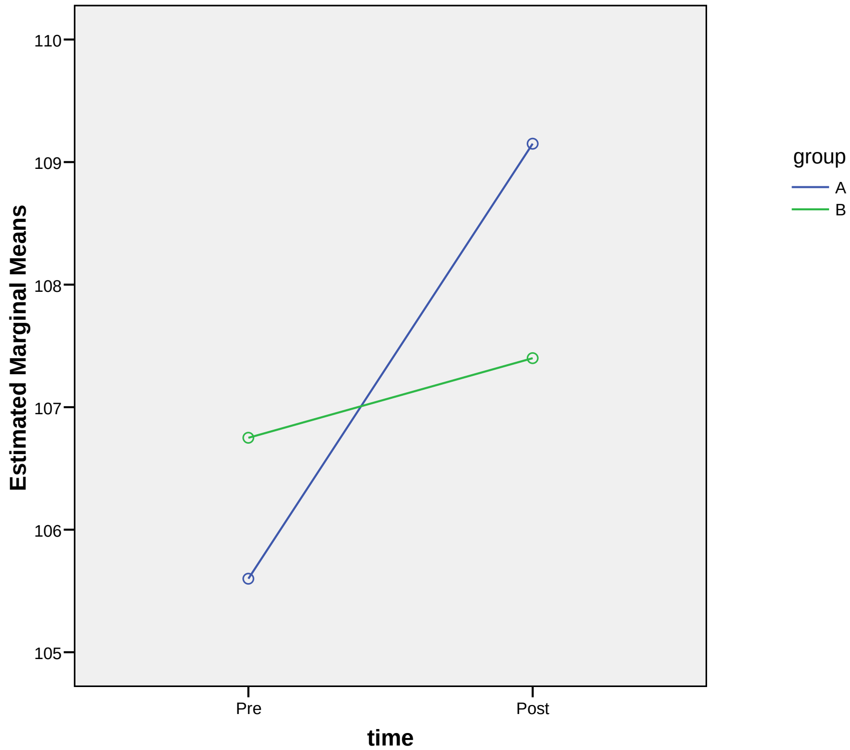


Figure 4: Mean bowling speed by time and group

Table 4 shows that there was a significant time effect for bowling speed thus in both groups combined the bowling speed values increased significantly over time. However, the time by group interaction effect was also significant (p=0.013) thus indicating that there was a significant treatment effect. Figure 4 shows that the profiles over time of the two groups were not parallel, and that the slope of Group A (intervention group) was steeper over time than that of Group B (Control group). The two lines crossed over, indicating that the effects on bowling speed over time in the two groups were not equal. The effect in the treated group was greater than that in the control group. Although the two groups started at around the same level pre treatment, after treatment the treated group had a much higher mean bowling speed than the control group.

4.4.4) Patient perception

Table 5: Patient perception of change by group

			patient perception question			Total
			Increase	Decrease	No Change	
group	A	Count	18	1	1	20
		% within group	90.0%	5.0%	5.0%	100.0%
	B	Count	11	4	5	20
		% within group	55.0%	20.0%	25.0%	100.0%
Total		Count	29	5	6	40
		% within group	72.5%	12.5%	15.0%	100.0%

Pearson chi square 6.156, p=0.046

There was a significant difference in the proportions of patient perception between the two groups (p=0.046). Table 5 shows that in the intervention group (A) the percentage that perceived an increase was 90%, while in group B (control) it was 55%. Also, the percentage that felt a decrease or no change was lower in the intervention group than in the control group. Therefore, patient perception of increase was significantly higher in the treated group than in the control group.

4.4.5) To determine the subjects' perceptions of change in bowling speed after the intervention compared to the actual change in bowling speeds post intervention.

Table 6: Actual change in bowling speed

	Frequency	Percent
Increase	28	70.0
Decrease	11	27.5
No Change	1	2.5
Total	40	100.0

Table 6 shows that in all 40 participants overall, 70% achieved an increase in bowling speed, 27.5% a decrease and 2.5% did not change.

Table 7: Perceived change in bowling speed vs. actual change in bowling speed

			Actual change			Total
			Increase	No Change	Decrease	Increase
Perceived change	Increase	Count	24	0	5	29
		Row %	82.8%	.0%	17.2%	100.0%
	No Change	Count	3	1	2	6
		Row %	50.0%	16.7%	33.3%	100.0%
	Decrease	Count	1	0	4	5
		Row %	20.0%	.0%	80.0%	100.0%
Total		Count	28	1	11	40
		Row %	70.0%	2.5%	27.5%	100.0%

NcNemar Bowker chi square = 7.667, p=0.053

Table 7 shows that there was a borderline statistically non-significant association between the perceived and actual change in bowling speed (p=0.053). The weighted Cohen's Kappa statistic was 0.427 which is considered as moderate agreement. The majority of observations was concordant (ie. Agreement between perceived and actual, n=29 highlighted in yellow). There were a few discordant observations where the perceived change was less than the actual change (n=4 highlighted in turquiose) and there were more discordant observations where the perceived change was more than the actual change (n=7 highlighted in green). Thus the trend was for the participants to overestimate their actual change.

4.4.6) To determine the correlation between Numerical Pain Rating Scale 101(NRS 101) and algometer to bowling speeds

Intervention group (A)

Change in bowling speed was significantly negatively correlated with change in NRS, ie as the pain decreased, the bowling speed increased (r= - 0.688). There was a strong positive correlation between change in bowling speed and change in algometer (r=0.799). Change in algometer and NRS were also strongly negatively correlated (r= -0.792). This is shown in Table 8.

Table 8: Correlation matrix of change in outcome variables in the intervention group

		Change in bowling speed	Change in NRS	Change in algometer
Change in bowling speed	Pearson Correlation	1	-0.688(**)	0.799(**)
	Sig. (2-tailed)		0.001	<0.001
	N	20	20	20
Change in NRS	Pearson Correlation	-0.688(**)	1	-0.792(**)
	Sig. (2-tailed)	.001		<0.001
	N	20	20	20
Change in algometer	Pearson Correlation	0.799(**)	-0.792(**)	1
	Sig. (2-tailed)	<0.001	<0.001	
	N	20	20	20

** Correlation is significant at the 0.01 level (2-tailed).

Control group (B)

There were no correlations between changes in outcome values in the control group. This is shown in Table 9.

Table 9: Correlation matrix of change in outcome variables in the Control group

		Change in bowling speed	Change in NRS	Change in algometer
Change in bowling speed	Pearson Correlation	1	.164	.058
	Sig. (2-tailed)		.491	.807
	N	20	20	20

Change in NRS	Pearson Correlation	.164	1	.139
	Sig. (2-tailed)	.491		.558
	N	20	20	20
Change in algometer	Pearson Correlation	.058	.139	1
	Sig. (2-tailed)	.807	.558	
	N	20	20	20

4.5 Summary and conclusion

Although both groups started out equal in terms of the outcome measurements, there was a significant treatment effect for all outcomes, and the treated group improved at a faster rate over time than the control group. However, there was a placebo effect detected in the control group. Perceived and actual change in bowling speed tended to agree to a moderate extent, but there was a slight trend towards participant's overestimating their change. In the intervention group but not in the control group there was a significant strong positive correlation between change in bowling speed and change in algometer, while the NRS and bowling speed and NRS and algometer measurements were strongly negatively correlated. The placebo effect detected in the control group as well as the participants' trend towards overestimating their change in bowling speed was most likely due to the Hawthorne Effect (Mouton and Marais, 1994).

CHAPTER 5

DISCUSSION OF RESULTS

5.1) Introduction

This chapter involves the discussion of the demographic data and the results, after analysis, of the data obtained from the study.

5.2) Demographics

Forty Action cricket bowlers who were symptomatic with respect to shoulder pain of a myofascial origin participated in the study. Despite the fact that in the game of Action cricket both males and females may participate (Routley and Valuri, 1993), no female Action cricket bowlers participated in the study. The participants' ages ranged from 18 to 36 years. These findings confirm that the majority of Action cricket players are young adults as reported by Thomas (2007). The mean Body Mass Index (BMI) of the participants in the study placed the majority of the participants in the "normal" to "overweight" categories for adults according to the World Health Organisation (Hanlon *et al*., 2006). These findings are most likely due to the fact that the majority of participants in the study play Action cricket on a part time basis, usually only once a week. The findings on the BMI suggest that the subjects who participated in the study could not be classed as elite athletes.

The majority of the participants in the study were right shoulder dominant (n = 38, (95%)) with only two participants having a left shoulder dominance (n = 2, (5%)). The most tender active myofascial trigger point of the rotator cuff musculature was located mainly in the Supraspinatus (n =22) and Infraspinatus muscles (n=16) with only two participants most tender active trigger point being located in the Teres minor muscle. The high prevalence of the most tender active myofascial trigger point within the Supraspinatus muscle is most likely due to the fact that this muscle is highly active during two phases of the throwing action.: during the early cocking phase when it countracts the sheer forces generated by the Deltoid muscle and also during the follow through stage where it functions with the other posterior rotator cuff muscles (Infraspinatus and Teres Minor) to decelerate the upper limb as it crosses the body (Dillman *et al*. 1993 and Jobe *et al.* 1983). The prevalence of the most tender active trigger point within Infraspinatus muscle and the Teres Minor muscle is most likely due to the muscles being maximally active during the follow through stage of the throwing action causing deceleration of the arm as it crosses the body (Dillman *et al*. 1993 and Jobe *et al.* 1983).

Results:

5.3) Numerical Pain Rating Scale (NRS-101)

The Numerical Pain Rating Scale (NRS-101) was used to provide subjective information about the levels of pain perceived by the patient both before and after the intervention. The pre-intervention values were compared with the post intervention values to monitor the effect of the treatment intervention. A decrease in the NRS value after the intervention indicated a decrease in the pain intensity experienced by the patient and therefore an improvement.

In the study it was found that in both groups the NRS values decreased over time. In the intervention group however there was a much larger reduction in the NRS ($p=0.037$) in comparison to the control group ($p= 0.357$). This indicates that intervention led to a significant decrease in the pain experienced by the participants.

These results shown are in keeping with the reports of Hong (1994) as well as Hseih *et al*. (2007), who both reported that dry needling leads to an immediate reduction in the pain experienced by the patient. The decrease in the NRS score in the control group was most likely due to the Hawthorne effect (Mouton and Marais, 1994).

5.4) Algometer

The algometer was used to measure the amount of force that first caused the patient any pain. Readings were taken both before and after the intervention to determine the intervention's effect on the pain experienced by the patient. Improvement would be signified by a decrease in pain sensitivity followed by an increase in the amount of pressure the patient would allow.

Prior to the intervention there was no significant difference between the two groups. After the intervention it was found that in both groups' algometer values increased after the intervention. However in the intervention group there was a statistically significant increase in the algometer readings (p=0.024) when compared to the control group (p=0.613) with the intervention group having a much higher mean algometer level than the control group. These findings show that in the intervention group the pain experienced decreased in sensitivity after the intervention.

These findings are also in keeping with the reports of Hong (1994) and Hseih *et al*. (2007), who stated that dry needling leads to an immediate reduction in the pain experienced by the patient. The moderate increase experienced by the control group may have also been as a result of the Hawthorne effect (Mouton and Marais, 1994).

5.5) Bowling Speed

Bowling speeds were recorded using the "Speedtrac" sports radar which measured the bowling speed in kilometers per hour. In the study the mean bowling speeds both pre and post-intervention of both groups were within the normal range (85-125km.h^{-1}) of bowling speeds for Action cricket fast bowlers as reported by Thomas (2007).

In both groups the pre intervention mean bowling speeds were at around the same level. It was observed that in both groups there was an increase in bowling speeds over time. However a significant improvement was shown in the intervention group (p= 0.013) when compared to the control group (p= 0.918), with the mean bowling speed in the intervention group being much higher than the mean of the control group.

These findings indicate that the dry needling intervention had a significant positive effect on the bowling speeds of participants in the study. The significant increase in the bowling speeds in the intervention group is most likely due to three main factors.

As has been reported in both algometer and NRS results, a large reduction in the pain experienced by the participants was observed after the intervention both subjectively (NRS-101) and objectively (algometer). These findings are in keeping with Hong (1994) who reported that dry needling leads to an immediate reduction in the pain experienced by the subject. Another factor which may have resulted in the increase in bowling speed in the intervention group was the fact that the presence of a myofascial trigger point in a specific muscle results in weakness of that muscle (Alvarez and Rockwell, 2002). This weakness is a guarding mechanism in which the muscle is prevented from contracting fully due to pain as a result of the myofascial trigger point (Gerwin, et al. 2004). The reduction of pain which has been reported earlier would then have allowed the muscle to contract maximally thus increasing the strength of the affected muscle and contributing to an increase in the bowling speed.

Another factor which may have an effect on bowling speed is the range of motion of the affected muscle. According to Travell, *et al.* (1999) a muscle containing a Myofascial trigger point is prevented from reaching its full stretch range of motion due to pain. This statement is in keeping with Grieve (2005) who in a case study observed that deactivation of myofascial trigger points resulted in an increase in the range of motion of the affected muscle. These findings were confirmed in a study conducted by Hseih *et al*. (2007) who reported that dry needling of the most tender myofascial trigger point of the shoulder musculature leads to an increase in both active and passive range of motion of internal rotation of the shoulder. This increase in the range of motion of the shoulder joint could have also contributed to the increase in the mean bowling speed of the intervention group.

5.6) Perception of change in bowling speed

It was observed that the patients' perception of an increase in bowling speed was much higher in the intervention group, with 90% of the participants in the intervention group reporting that they felt that they bowled faster after the dry needling intervention. The majority of the participants in the intervention group reported feeling "looser" post intervention. This felling of "looseness" was most likely due to the increase in the range of motion of the affected muscle as a result of the dry needling intervention which was reported by Grieve (2005) and was discussed earlier.

5.7) Perception of change in bowling speed after the intervention compared to actual change in bowling speed.

The majority of the participants in the study (n= 29) correctly correlated their actual increase in bowling speed to their perceived increase. However it was found that there was a trend among some participants to overestimate their actual change in bowling speed. This finding may be as a result of the Hawthorne effect (Mouton and Marais, 1994).

5.8) The correlation between Numerical Pain Rating Scale (NRS-101) and algometer to bowling speeds.

As was reported in the study there was a significantly negative correlation between the change in NRS and the bowling speed. This means that as the NRS values decreased (ie: the participants' pain decreased) the bowling speeds increased. In terms of the algometer results a strong positive correlation was observed, showing that as the participants' pain pressure threshold increased their bowling speed increased. These findings indicate that the pain experienced by the participants prior to the dry needling intervention had a strong negative effect on bowling speed. Once the pain was relieved by the intervention the bowlers were able to bowl at a significantly faster speed than prior to the intervention.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1) Conclusion

The results of the study indicate that the dry needling intervention had an immediate and beneficial effect on participants in the study.

Dry needling as a form of treatment for active myofascial trigger points appears to be more effective than no treatment (control) in both increasing the speed at which the participant delivers the ball as well as decreasing the pain experienced by the participant as a result of an active myofascial trigger point.

In terms of bowling speed it was observed that in the intervention group a statistically significant increase in bowling speed was observed after the intervention, with the mean increase in bowling speed in the intervention group being 3.5km/h.

There was also a statistically significant decrease in the pain experienced by the participants immediately after the intervention, which was observed both subjectively (Numerical Pain Rating Scale) as well as objectively (Algometer).

This study also indicates that the majority of the participants also experienced a perceived beneficial effect after the dry needling intervention, with 90% of the participants in the intervention group indicating that they felt that they bowled at a faster speed after the dry needling intervention.

The findings of this study suggest that dry needling as a treatment modality would be beneficial to cricket fast bowlers in not only increasing the speed at which they deliver the ball but also decreasing the pain experienced by the bowler as a result of active myofascial trigger points.

6.2) Recommendations

- Further research should focus on professional cricket fast bowlers to determine the degree of improvement in bowling speed in high performance professional athletes who are subject to high workloads and stresses placed upon their bowling shoulders and in particular their rotator cuff muscles.

- Further research should also be conducted on an outdoor cricket pitch where bowlers will have a full run up length as opposed to the shortened length in indoor cricket. The findings of this study will be more representative of the effect of the treatment on bowling which occurs in professional and international cricket games.

- Range of motion testing using an inclinometer should be conducted both before and after the dry needling intervention to determine the intervention,s effect on range of motion of the shoulder joint.

- Treatment modalities such as ice and APS could be added to the dry needling intervention in an attempt to further decrease the pain experienced by the participant and possibly the speed at which the ball is delivered.

- A placebo treatment could be added to observe if a placebo effect is noted and the degree to which a placebo treatment can affect bowling speed.

REFERENCES

Adolfsson, L. and Lysholm, J. 1991. Arthroscopy for the diagnosis of shoulder pain. *International Orthopeadics, 15(4):275-278.*

Andrews, J.R., Wilk, J.E. 1994. The Athletes shoulder. Churchill Livingston Inc. New York.

Audie, G. 2005. The association between active myofascial trigger pointsof the shoulder external rotator myotactic unit on alternating internal and external peak torque and single repetitive work ratios in overhead throwing atheletes. Mtech. Thesis, Durban University of Technology, Durban.

Alpert , M., Pink , F., Jobe , P., McMahon , W. and Mathiyakom, S. 2000. Electromyographic analysis of deltoid and rotator cuff function under varying loads and speeds. *Journal of Shoulder and Elbow Surgery*, 9(1): 47 – 58.

Alvarez, D.J. and Rockwell, P.G. 2002. Trigger points: diagnosis and management. *The American Family Physician,* 65(4):653-660.

Baldry, M . and Cummings , P . 2002. Regional myofascial pain: diagnosis and management. *Best Practice & Research Clinical Rheumatology*, 21(2) , 367 – 387.

Bartlett, R.M., Stockill, N.P., Elliot, B.C. and Burnett, A.F. 1996. The Biomechanics of fast bowling in men's cricket: A review. *Journal of Sports Sciences,* 14:403-424.

Bernhadt, O., Schiffman, E.L. and Look, J.O. 2007. Reliability and validity of a new fingertip-shaped pressure algometer for assessing pressure pain thresholds in the temporomandibular joint and masticatory muscles. Journal of Orofacial Pain, 21:29-38.

Burkhart, S.S., Morgan, C.D. and Kibler, W.B. 2003. The disabaled throwing shoulder: spectrum of pathology part I: Pathoanatomy and Biomechanics. *Arthroscopy: The Journal of Arthroscopic and Related Surgery*, 19:404-420.

Chappell, G. 1975. *Successful Cricket: from beginner to expert in forty lessons*. London: Pelham

Chatiow, L. and Delany, J.W. 2002. Clinical Application of Neuromuscular Techniques. Volume 2- The Lower Body. Churchill Livingston, Elsevier Science Limited, Edinburgh, Scotland. ISBN 0443 06284 6.

Dennis, R.J., Finch, C. and Farhart, P.J. 2005. Is bowling workload a risk factor for injury to Australian junior cricket fast bowlers*? British Journal of Sports Medicine,* 59 *(6):* 1469-1476.

Dillman, C.J., Fleisig, G.S. and Andrews, J.R. 1993. Biomechanics of pitching with emphasis upon shoulder kinematics. *The Journal of Orthopeadic and Sports Physical Therapy,* 18(2):402-408.

Dommerholt, J., Mayoral del Moral, O. and Grobli, C. 2006. Trigger point dry needling. *The journal of Manual and Manipulative therapy*, 14(4): 70-87.

Escamilla, R.F., Barrentine, S.W., Fleisig, G.S., Zheng, N., Takada, Y., Kingsley, D. and Andrews, J. 2007**.** Pitching Biomechanics as a Pitcher Approaches Muscular Fatigue During a Simulated Baseball Game. *The American Journal of Sports Medicine* 35:23-33.

Esenyel, M., Caglar, N and Aldemir, T. 2000. Treatment of Myofascial Pain. *American Journal of Phyical and Medical Rehabilitation*, 79**:**48-52.

Finch, C., Cassell, E. and Stathakis, V. 1999. The epidemiology of sports and active recreation injury in the Latrobe Valley. Monash University Accident Research Centre, Victoria, Australia, Report No: 151:26-34.

Fischer, A.1996. Injection techniques in the management of local pain. *Journal of Musculoskeletal Rehabilitation,* 7:107-17.

Freedman, L. and Munro, R.R. 1996. Abduction of the arm in the scapular plane: scapular and glenohumeral moements: a roentgenographic study. Journal of Bone and Joint Surgery, 48:1503.

Gerwin , R.D., Dommerholt, J. and Shah, J.P. 2004. An expansion of Simons' integrated hypothesis of trigger point formation. *Current pain and headache reports*, 8(6):468-475

Greive, R. 2005. Proximal hamstring rupture, restoration of function without surgical intervention: A case study on myofascial trigger point pressure release. *Journal of Bodywork and Movement Therapies*, 9:27–34.

Glousman, R.E. 1993. Electromyograhic analysis and its role in the athletic shoulder. *Clinical Orthopeadic, 288:89-99.*

Han, C. and Harrison, P.1997. Myofascial Pain Syndrome and Trigger Point Management. *Regional Anesthesia*, 22(1): 89-101.

Hanlon, C., Keith, S.W., Redden, D.T., Katzmarzyk, P.T., Boggiano, M.M., Benca, R.M., Ruden, D., Pietrobelli, A., Barger, J.L., Fontaine,F., Wang, C., Aronne, L.J., Wright, S.M., Baskin, M., Dhurandhar, N.V., Lijoi, M.C., Grilo, C.M., DeLuca, M., Westfall, A.O. and Allison, D.B. 2006. Putative contributors to the secular increase in obesity: exploring the roads less traveled. *International Journal of Obesity,* 30:1585-1594*.*

Hopkins, J.T., Ingersoll, C.D**.** 2000. Arthrogenic muscle inhibition: a limiting factor in joint rehabilitation. *Journal of Sport Rehabilitation*; 9(2):135-159,

Hsieh, Y.L., Kao, M.J., Kuan, T.S., Chen, S.M., Chen, J.T., Hong, C.Z. 2007. Dry needling to a key myofascial trigger point may reduce the irritability of satellite myofascial trigger points. American Journal of Physical and Medical Rehabilitation,86:397-403.

Hong, C.Z. 1994. Lidocaine injection versus dry needling to myofascial trigger point: The importance of the local twitch response. *American Journal of Physical and Medical Rehabilitation*, 73:256-63.

Indoor Cricket website [online]. 2007. Available from: http://www.indoorcricketworld.com/ [Accessed 25 Febuary 2008].

International Cricket Council [online]. 2007. Available from: http://www.icc-cricket.com/ [Accessed 25 Febuary 2008].

Ingersoll, C.D., Stone, M.B., Edwards, J.E., Stemmans, C.L., Palmieri, R.M. and Krause, B.A. 2003. Certified athletic trainers' perceptions of exercise-associated muscle cramps. *Journal of Sports Rehabilitation*, 12:333-342.

Jobe, F.W., Tibone, J.E., Perry, J. and Moynes, D. 1983. An EMG analysis of the shoulder in throwing and pitching. *The American Journal of Sports Medicine* 11:3-5.

JTech Industries Pressure Threshold Meter [online]. 2002. Available from http://ww.jtechmedical.com/products [Accessed 6 September 2007].

Lee, S.B., Lawrence, J., Berglund, B.S., Linda, L. and Kai-Nan, A.N. 2000. The Effect of a Glenoid Defect on Anteroinferior Stability of the Shoulder After Bankart Repair: A Cadaveric Study. *The Journal of Bone and Joint Surgery*, 82:35-46.

Lewis, T. 1992. MCC Masterclass. *The new MCC coaching book.* London: Weidenfeld and Nicolson.

Lucas, K.R., Polus, B.I. and Rich, P.S. 2004. Latent myofascial trigger points: Their effect on muscle activation and movement efficiency*. Journal of Bodywork and Movement Therapy,* 8:160-166.

Lyman, S., Dunn W.R., Schackman, B.R. and Walsh, C. 2005. Variation in Orthopaedic Surgeons' Perceptions about the Indications for Rotator Cuff Surgery. *American Journal of Bone and Joint Surgery,* 87 (9): 1978-84.

Magee, D.J. 1997. Orthopedic Physical Assesment-3rd edition. Philadelphia. W.B. Saunders Company.

Marylebone Cricket Club. 1990. *Cricket.* 10th ed. London: A & C Black (Publishers) Ltd.

McCarney, R., Warner, J., Iliffe, S., Van Haselen, R., Griffin, M. and Fisher, P. 2007. The Hawthorne Effect: a randomised, controlled trial. *BMC Medical Research Methodology; 7:30.*

Meister, K. 2000. Injuries to the Shoulder in the Throwing Athlete. *The American Journal of Sports Medicine,* 28:587-601.

Mouton, J. and Marais, H.C. 1994. Basic Concepts in methodology of the social sciences. Pretoria: HSRC Publishers.

Moore, K.L. and Dalley, A.F. 2005. Clinically Oriented Anatomy. 5th ed. Baltimore: Lippincott Williams and Wilkins.

Myers, M.A., Rosier, R.N. and Puzas, J.E. 2007. Scapular Position and Orientation in Throwing Athletes. *American Journal of Sports Medicine.* 33: 263-271.

Neer, C.S. 1983. Impingement lesions. *Clinical Orthopeadics and Related Research,173:70-77.*

Nicholas, J.A. and Hershman, E.B., 1995. The Upper Extremity in Sports Medicine. 2nd Ed. Mosby year book inc. St Louis Missouri 63146.

Routley, V. and Valuri, J. 1993. Adult Sports Injury. *Hazard; 15: 1-13.*

Scott, A.T.C., Lephart, M. and Jari, R. 2002. The role of proprioception in shoulder instability *.Department of Orthopaedics, UPMC Center of Sports Medicine,Pittsburgh, PA, USA Operative Techniques in Sports*, 10: *2-4.*

Shah, J., Phillips, T., Danoff, J., Takacs, L., Desai, M. and Gerber, L. 2006. Local Biochemical Milieu and Response to Needle Insertion in the Upper Trapezius Muscle With Active, Latent, and Absent Myofascial Trigger Points. *Archives of Physical Medicine and Rehabilitation*, 87(11): 3 – 4.

Sola, A.E., Rodenburger, M.L. and Getty, B.B. 1955. Incidence of Hypersensitive areas in Posterior Shoulder Muscles. *American Journal of Physical Medicine*. 34:585-590.

Sood, K. 2007. The immediate effect of lumbar spine manipulation, thoracic spine manipulation, combination lumbar and thoracic spine manipulation and laser on bowling speed in action cricket fast bowlers. MTech. Thesis, Durban University of Technology, Durban.

SpeedTrac Sports Radar Gun Setup [online].2006.Available from http://www.astroproducts.net/works.htm [accessed 7 September 2007].

Stretch, R.A. 1993. The incidence and nature of injuries in first league and provincial cricketers. *South African Medical Journal*, 83: 339-42.

Travell, J.G., Simons, D.G. and Simons, L.S. 1999. Myofascial pain and dysfunction: Trigger Point Manual. 2nd edition. Baltimore: Williams & Wilkins.

Thomas, J. 2007. Interviewed by D.Subrayan. Durban North Action Sports Arena, Durban, 19 January 2008 20h30.

Van der Hoeven, H. and Kibler, W.B. 2006. Shoulder injuries in tennis players. *British Journal of Sports Medicine*. 40(5):435-40.

Wheeler, A.H. 2004. Myofascial pain disorders: theory to therapy. *Drugs*, 64(1): 45-62.

Wilk, K.E., Arrogo, C.A. and Andrews, J.R. 1991. Standardized isokinetic testing protocol for the throwing shoulder: The throwers series. *Isokinetic exercise Science*, 1: 63-69.

Wilks, C.L. 2003. The Therapeutic Efficacy of Dry Needling Latent Myofascial Trigger Points. MTech. Thesis, Durban University of Technology, Durban.

APPENDICES

A- Case history

B- Physical examination

C- Shoulder regional exam

D- Warm up and stretching procedure

E- Letter of Information

F- Participant perception questionnaire

G- Advertisement

H- Informed consent form

Appendix A

DURBAN UNIVERSITY OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: ______________________________ Date: __________

File # : ______________ Age: __________

Sex : __________ Occupation: ______________________

Intern : ______________________ Signature ______________

FOR CLINICIANS USE ONLY:
Initial visit
Clinician: Signature :

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

CASE STATUS:

PTT:	Signature:	Date:

CONDITIONAL:
Reason for Conditional:

Signature: Date:

Conditions met in Visit No:	Signed into PTT:	Date:
Case Summary signed off:		Date:

Intern's Case History:

1. **Source of History:**

2. **Chief Complaint : (patient's own words):**

3. **Present Illness:**

	Complaint 1	Complaint 2
▸ Location		
▸ Onset : Initial:		
Recent:		
▸ Cause:		
▸ Duration		
▸ Frequency		
▸ Pain (Character)		
▸ Progression		
▸ Aggravating Factors		
▸ Relieving Factors		
▸ Associated S & S		
▸ Previous Occurrences		
▸ Past Treatment		
▸ Outcome:		

4. **Other Complaints:**

5. **Past Medical History:**

- General Health Status
- Childhood Illnesses
- Adult Illnesses
- Psychiatric Illnesses
- Accidents/Injuries
- Surgery
- Hospitalizations

6. **Current health status and life-style:**

- Allergies
- Immunizations
- Screening Tests incl. x-rays
- Environmental Hazards (Home, School, Work)
- Exercise and Leisure
- Sleep Patterns
- Diet
- Current Medication
  Analgesics/week:
- Tobacco
- Alcohol
- Social Drugs

7. **Immediate Family Medical History:**

- Age
- Health
- Cause of Death
- DM
- Heart Disease
- TB
- Stroke
- Kidney Disease
- CA
- Arthritis
- Anaemia
- Headaches
- Thyroid Disease
- Epilepsy
- Mental Illness
- Alcoholism
- Drug Addiction
- Other

8. **Psychosocial history:**

- Home Situation and daily life
- Important experiences
- Religious Beliefs

9. **Review of Systems:**

- General
- Skin
- Head
- Eyes
- Ears
- Nose/Sinuses
- Mouth/Throat
- Neck
- Breasts
- Respiratory
- Cardiac
- Gastro-intestinal
- Urinary
- Genital
- Vascular
- Musculoskeletal
- Neurologic
- Haematologic
- Endocrine
- Psychiatric

Durban University of Technology

PHYSICAL EXAMINATION: SENIOR

Patient Name : ______________________ **File no :** ________ **Date :** ________

Student : **Signature :**

VITALS:

Pulse rate:				Respiratory rate:	
Blood pressure:	R	L		Medication if hypertensive:	
Temperature:				Height:	
Weight:	Any recent change? Y / N		If Yes: How much gain/loss	Over what period	

GENERAL EXAMINATION:

General Impression		
Skin		
Jaundice		
Pallor		
Clubbing		
Cyanosis (Central/Peripheral)		
Oedema		
Lymph nodes	Head and neck	
	Axillary	
	Epitrochlear	
	Inguinal	
Pulses		
Urinalysis		

SYSTEM SPECIFIC EXAMINATION:

CARDIOVASCULAR EXAMINATION

RESPIRATORY EXAMINATION

ABDOMINAL EXAMINATION

NEUROLOGICAL EXAMINATION

COMMENTS

Clinician: **Signature :** ______________________

DURBAN UNIVERSITY of TECHNOLOGY

SHOULDER REGIONAL EXAMINATION

Patient: .... File No: .... Date: ....

Intern: ....Signature: ....

Clinician: ....Signature: ....

Observation

Posture		S-C Joints	
Skin		Clavicles	
Swelling		A-C Joints	
Shoulder levels		Scapulae	
Comments			

Palpation

S-C Joint:		SCM:	Scalenes:
Sternum:		Ribs and costal cartridge:	
Clavicle:		Coracoid process:	
A-C Joint:		Acromion:	
Greater Tuberosity:			
Lesser Tuberosity:			
Intertubercular (bicipital groove):			
Trapezius:		Deltoid:	
Biceps:		Triceps:	
Supraspinatus insertion:			
Musculotendinous portion of supraspinatus:			
Axilla:	Lymph nodes:		
	Brachial artery:		
	Serratus anterior (medial wall):		
	Pectoralis major (anterior wall):		
	Lattisimus dorsi (posterior wall):		
Scapula	Borders:	Spine:	
	Supraspinous fossa:		
	Infraspinous fossa:		
Cervico-thoracic spine:			

Active Movements (note ROM and pain)

Elevation through abduction (170-180°):	
Painful arc with abduction:	
Elevation through forward flexion (160-180°):	
Elevation through scapula plane (170-180°):	
Lateral rotation (80-90°):	Medial rotation (60-100°):
Extension (50-60°):	Adduction (50-75°):
Horizontal adduction/abduction (130°):	
Circumduction (200°):	
Apley's Scratch:	

Passive movements (note end-feel, ROM and pain)

Elevation through abduction (bone to bone or tissue stretch)..........

Elevation through forward flexion (tissue stretch)..........

Lateral rotation (tissue stretch)..........

Medial rotation (tissue stretch)..........

Extension (tissue stretch)..........

Adduction (tissue approximation) ....

Horizontal adduction (tissue stretch or approximation)..........

Horizontal abduction (tissue stretch)..........

Quadrant Test..........

Resisted Isometric Movements (note strength and pain)

Flexion		Medial rotation	
Extension		Lateral Rotation	
Adduction		Elbow flexion	
Abduction		Elbow extension	

Joint Play Movements (and motion palpation)

SC Joint	Supero-inferior (shrug shoulder with arm at side):
	Horizontal add/abduction (arm abducted 90°):
AC Joint	A-P Shear:
	Supero-inferior shear:
Scapula	Normal scapulo-humeral rhythm?:
	General mobility of scapula:

Glenohumeral Joint

Lateral movement of humeral head ______

Inferior movement of humeral head (Caudal glide)(50°) ______

Anterior movement of humeral head (P-A glide) (25°) ______

Posterior shear of humeral head (A-P glide) **>50%** At 10° flexion ______

At 90° flexion ______

Backward glide of humeral head in abduction ______

Long-axis distraction of humeral head in abduction ______

Downward and backward (S-I → A-P) ______

Outward and backward (med-lat → A-P ______

External rotation of humeral head ______

Internal rotation of humeral head ______

Instability Tests

1. Anterior Instability Tests

	R Pos	R Neg	R n/a	L Pos	L Neg	L n/a
Anterior drawer Test						
Rowe Test						
Fulcrum Test						
Apprehension (crank) Test						
Clunk Test (tear of labrum)						
Rockwood Test						

2. Posterior Instability Tests

	Pos	Neg	n/a	Pos	Neg	n/a
Posterior Apprehension Test						
Norwood Stress Test						
Push-pull Test						
Jerk Test						

3. Inferior and Multi-directional instability tests

	Pos	Neg	n/a	Pos	Neg	n/a
Inferior Shoulder Instability Test						
Feagin Test (antero-inferior instability)						

A-C Joint Stress Test: ______________________________

S-C Joint Stress Test: ______________________________

Tests for Muscle or Tendon Pathology

1.	Speed's Test (bicipital tendonitis)	
2.	Gilchrest Sign (bicipital tendonitis)	
3.	Supraspinatus Test (supraspinatus tendonitis)	
4.	Hawkins-Kennedy Impingement Test (supraspinatus tendonitis)	
5.	Drop –arm Test (rotator cuff tear)	
6.	Impingement Test	
7.	Pectoralis Major Contracture Test	
8.	Ludington's Test (rupture of long head of biceps)	

Tests for neurological function

Brachial Plexus Tension Test	Radial Nerve													
	Median Nerve													
Tinel's Sign (Scalene triangle)														
Dermatones	C4		C5		C6		C7		C8		T1		T2	
Reflexes	Biceps(C5/6)						Triceps (C7/8)							

Thoracic Outlet Syndrome Tests

Adson's Test		Halstead's Test	
Costoclavicular Test		Eden's Test (cervical rib)	
Hyperabduction Test		Roos Test	
Allen's Test			

Appendix D

Participant Stretch Procedure

Each participant in the study will be required to go through a set ten minute stretching and warm up procedure prior to bowling. The researcher will demonstrate to the participants how to perform each of theses stretches according to the methods described by Travell and Simons (1993). These will include:

1. A seated self-stretch for the hamstrings (1 minute). The long-seated reach exercise can be performed for hamstring self- stretch. The initial stretch can be performed by slowly and gently sliding the fingers down the shins, keeping the knees straight. Post isometric relaxation combined with deep breathing can enhance relaxation in the hamstrings.

2. A prone self-stretch for the quadriceps (30 seconds each side). The participant lies on the opposite side to the side being stretched, and uses his/her hand to hold the ankle and slowly bring the heel against the buttock to flex the knee fully while maintaining and then increasing extension of the thigh at the hip by also pulling the knee and thigh posteriorly.

1. A supine self-stretch for the Quadratus Lumborum (30 seconds each side). The starting position for this stretch is supine, with the hips and knees bent. The hands are placed behind the head to elevate the rib cage. The controlling left leg is crossed over the right thigh (the side to be stretched). After the right thigh has been adducted as far as it will go without resistance, during slow deep inhalation, the left leg is used to resist a gentle isometric abductive effort of the right thigh. As the participant slowly exhales and relaxes the right side, the left leg gently pulls the right thigh medially and downward, which rotates and pulls the right half of the pelvis caudad- this takes up slack in the quadratus lumborum. The same is done for the left side.

2. A standing self stretch for the pectoralis major (1 minute). The In-doorway stretch will be performed by the participant. He will stand in a narrow doorway with the forearms against the doorjambs. One foot is placed in front of the other, and the forward knee is bent. The participant holds the head erect looking down at the floor. As the forward knee bends and the patient leans though the doorway, a slow, gentle, passive stretch is

exerted bilaterally on the pectoralis major. The hand position against the doorjamb can be adjusted to vary the stretch on different sections of the muscle.

5. A standing anterior shoulder stretch (1 minute). In this stretch the participant is standing with shoulders relaxed and back. The participant will then clasp their hands behind their lower back, then lift their clasped hands, keeping your elbows straight, back out away from your body.

6. A standing posterior shoulder stretch (1 minute). In this stretch the participant brings their dominant arm horizontally across the front of the body. The dominant arm is held in position by the hand of the opposite arm. The dominant arm is gently flexed and pulled across the chest until a stretch is felt in the back of the shoulder.

The patient will then be required to warm up by doing light jogging for five minutes. This Jogging will in the action cricket nets with the participant jogging up and down the length of the action cricket pitch. The participant will be monitored by the researcher while they are jogging to prevent any injury or fatigue of the participant.

Appendix E

LETTER OF INFORMATION

Title of research
The immediate effect of dry needling the most tender active myofascial trigger points within the rotator cuff musculature on bowling speed in Action C23ricket bowlers.

RESEARCH SUPERVISOR: Dr A. Docrat (M.Tech Chiropractic) (031 3732589)

RESEARCH STUDENT: Darren Subrayan 0828046453

INSTITUTION: Durban University of Technology

Dear Patient
Welcome and thank you for participating in the study! This form will give you more information regarding the study and what it entails before you sign.

Introduction:
This study involves research on forty action cricket bowlers with active myofascial trigger points in their rotator cuff muscles; these trigger points will then be dry needled using and bowling speeds will be compared before and after the dry needling intervention. Dry needling is a treatment in which an acupuncture needle is inserted through the skin into the muscles of the body. In the study the participants will be divided into two groups. Only one of these groups will receive the dry needling intervention while the other group will receive no treatment.

Procedure:
1. In this study you will firstly undergo a full case history, physical exam, and shoulder regional exam.
2. Firstly, you will be put through a set eight minute stretching and warm-up procedure, so as to warm up and prevent injury.
3. Thereafter, you will be asked to bowl two balls in the action cricket nets as fast as you possibly can. The average speed of these deliveries will be measured and noted.
4. The researcher will then feel for the most tender spot located in your rotator cuff muscles of the shoulder, this tender spot is referred to as a myofascial trigger point.
5. Then, depending on the group you are in, you will either receive dry needling of the most tender trigger point of your rotator cuff muscles of the shoulder or you will receive no treatment at all.
6.Immediately after the dry needling procedure you will required to again bowl two balls as fast as possible. The average speed of these deliveries will again be measured and compared to the first set of results. If you wish you may then be informed of both sets of averages recorded in the study.

7. If you are in the group which does not receive the dry needling intervention you will be entitled to receive the dry needling intervention on completion of the study. This will occur after you have bowled for a second time in the action cricket nets.

Risks and Discomforts

Dry needling is a safe procedure and will do no harm to you as the patient. You may however experience some soreness in the area were the needle was inserted, this is normal and should subside in a few days.

Costs

There are no costs for any of the participants in this study.

Remuneration

There are no financial or other rewards offered in this study. All participants will qualify for one free consultation pertaining to a musculoskeletal complaint (eg: back pain, shoulder pain, knee pain etc.)

Confidentiality

Only the researcher and his supervisor will have access to your names and your names will also not be revealed in the data sheets. If you have any queries about the study that have not been properly explained to you by the researcher you may contact the supervisor. If you are not satisfied with a particular area of this study, please feel free to forward any concerns to the Durban University of Technology Research and Ethics Committee or you may contact the Dean of the faculty of Health Sciences, Professor N. saGwele (031-3732704).

Appendix F-

Participant Perception questionnaire

Dear Participant,

Did you feel that your bowling speed increased, decreased, or did not change after the intervention? Tick the appropriate block.

Table 1

Increased	Decreased	No change

Appendix G: Advert

SHOULDER PAIN ?

Are you a Cricket Bowler?
(All action cricket players as well)

18 to **40**

years of age, and interested in having your **bowling speed measured?**

WHICH INCLUDES
A FREE MEASUREMENT OF YOUR BOWLING SPEED USING A SPEEDCHECK SPORTS RADAR.

FREE TREATMENT
IS AVAILABLE ON COMPLETION OF THE STUDY

If you are interested please contact
Darren - (cell) 0828046453

Appendix H

INFORMED CONSENT FORM

Date

Title of research project: The immediate effect of dry needling of the most tender myofascial trigger points within the rotator cuff musculature on bowling speed in action cricket fast bowlers.

Name of Supervisor: Dr .A. Docrat Tel: (031) 373 2589

Name of research student: Darren Subrayan Tel: 082 8046453

Please circle the appropriate answer **YES/NO**

1. Have you read the research information sheet? Yes/ No
2. Have you had an opportunity to ask questions regarding this study? Yes/ No
3. Have you received satisfactory answers to your questions? Yes/ No
4. Have you had an opportunity to discuss this study? Yes/ No
5. Have you received enough information about this study? Yes/ No
6. Do you understand the implications of your involvement in this study? Yes/ No
7. Do you understand that you are free to withdraw from this study? Yes/ No
   - At any time
   - Without having to give any reason for withdrawing, and
   - Without affecting your future health care.
8. Do you agree to voluntarily participate in this study Yes/No
9. Who have you spoken to?.. Yes/No

Please ensure that the researcher completes each section with you.
If you have answered NO to any of the above, please obtain the necessary information before signing.

Please Print in block letters:

Patient/ Subject Name: …………………………………..Signature:…………………………

Clinician Name: ……………………………………….Signature:…………………………

Witness Name: ………………………………………...Signature:…………………………

Research Student Name: …………………………………Signature:………………………..